THE ELECTRICAL REVIEW

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THE INSULATION OF CONDUCTORS.

MUCH uncertainty prevails as to the definite amount of insulation a cable should possess in order to withstand a current of high potential where arc lighting is required, say a current of 2,000 volts. It is supposed that a cable having an insulation resistance of about 100 megohms per mile being sufficient for low potential on an incandescent circuit, is utterly insufficient where high potential is required, but is it so? It may well be asked, has any one taken the trouble to investigate the fact whether a uniformly insulated cable having as low a dielectric resistance as 100 megohms per mile is not sufficient to carry safely a current with the high potential of 2,000 volts? It may, however, be safely assumed that if a cable with that dielectric resistance can safely carry a current for arc lighting, it will easily carry one for incandescent lighting. The relative figures of volts in the case of pressure and megohms in the case of resistance are not generally very clearly comprehended. In the case of a mile of cable carrying an arc lighting current under an E.M.F. of 2,000 volts, we have that figure as representing the pressure, and 100 megohms as representing the dielectric resistance. With regard to the disruptive pressure, this is practically the same at every point of the length, no matter what the latter may be. With the dielectric resistance the case, however, is perfectly distinct and different. Here we have an insulated cable giving as its value for the dielectric resistance 100 megohms for the entire mile, which represents the loss at every point or every yard throughout the whole length of the cable summed up altogether. Now, the amounts which represent the leakage of every single yard (each single yard in a uniformly insulated cable should give the same as every other yard) added all together do not express the resistance offered to the pressure of the current which is uniform at every point; the uniform resistance of the cable at every point should be given in order for one to obtain its exact value as an insulating medium opposing the high pressure. Taking a yard of cable, for instance, we have at the rate of 100 megohms per mile a dielectric resistance of 176,000 megohms. If we take the pressure of 2,000 volts at an inch of cable, the resistance offered in that inch is 6,336,000 megohms, and still further, at say the one-thousandth of an inch, we have on the one hand the constant pressure of 2,000 volts; and on the other, a dielectric resistance opposing it of 6,336,000,000 megohms, over 6,000 million megohms. And this resistance, be it remembered, in a uniformly insulated cable of 100 megohms per mile at every point of ·001 inch throughout its length is opposed to the constant pressure of 2,000 volts. Arguing in this way, it is obvious that we can arrive at the conclusion that an infinitely thin covering can effectually resist an infinitely high pressure, but here the question of "striking distance" comes in, and it is therefore really the thickness of the dielectric that determines finally the resisting power of the same. Strictly speaking, therefore, the insulation resistance should be accepted as the standard only in so far as it determines the thickness of the dielectric.

THE ELECTRIC LIGHTING ACT.

THE prevalent opinion regarding the effect of the passing of the Electric Lighting Bill upon the electric lighting industry is that it will be a beneficial one. There are still regrets that the measure was not of a more sweeping order; indeed, nothing short of the entire cancellation of the Act of 1882, even though it were replaced only by a short Act giving companies bare running powers, would content one well known gentleman with whom we have been in communication upon the matter; but generally speaking, there is a tone of greater confidence in the lighting world, and capitalists express their willingness to provide the all-important sinews under the amended conditions. This is undoubtedly a great point gained, and progress is now inevitable. Whether that progress will be as great as it would have been under other conditions is another matter. The new Act is not perfect; but it has to be made the best of, for there is little likelihood of further amendment for a long time to come. One point which is liable to cause dissatisfaction is that the local authority has still the power of absolute veto; that is, it can prevent a scheme from ever getting beyond the vestry, and it is to be feared that the vestries will use their power of veto with a view to the extortion of concessions from the lighting companies which will minimise the latter's success. Those who have had experience of those somewhat peculiarly constituted bodies, the London vestries, are not very sanguine that they will be inclined to go far out of their way to make things smooth for the electric lighting "undertakers," to use the uncouth phrase of the Act. Another point which is unsatisfactory is that it is compulsory upon the lighting company to connect on any customer who may desire connection, no matter how the premises to be lighted are wired. The London shopkeeper believes in competition before everything, and cases may be anticipated where the wiring will be done on the cheap and nasty principle by people who, having no responsibility beyond making the work just good enough to test up to a certain standard the first day of connecting up, will carry it out in a way which is certain to give a great deal of trouble to the engineers of the central stations.

But, while the Act does not meet with unqualified approval, it is gratifying to learn that the feeling in favour of electric lighting is gradually growing stronger. One important company informs us that within the last two months it has had a larger number of applications from intending purchasers and users of the electric light than have been received in the same period for years. The great difference in the cost of installations, no doubt, is having a material effect, as well as the increase which has taken place in the efficiency of dynamos and lamps. Altogether, while there is no reason to believe that those happy times so confidently predicted in 1882 are close upon us, a period of considerable activity and of substantial work may be anticipated.

WE have been favoured with a list of the Council, &c. of the British Association of Medical Electricians, of which august body the eminent C. B. Harness is President. As we cannot give the names on our own authority, we do not vouch for the accuracy of the list, although a correspondent assures us of its correctness. The first mentioned personage is said to be the corresponding clerk to the "President"; the second a female book-keeper; the third a shopman; the fourth is no less a celebrated individual than Dr. Carter Moffat of ammoniaphone fame; the fifth a Mr. Leeson; and last of all Mr. Sharman, an advertisement clerk. With the exception of Messrs. Carter Moffat and Leeson, who we believe are connected with the President in business matters, the members of the Council appear to be all in his employ. The name of Mr. Sharman will be fresh in the minds of our readers as asking for a fee of 10s. 6d. from one of our friends who, with the laudable desire of still further delving into the mysteries of medical electricity, applied for particulars of the objects of the association. What a subject for the late Charles Dickens to have handled! The characters in the "Pickwick Papers" are unapproachable in their own peculiar domain, but there are those now living who are still more wonderful creations than the imaginary beings which the eminent novelist has given to the world.

IT is not a little curious to note the strange fascination which electrically propelled launches appear to exercise upon the minds of those who first of all start, full of enthusiasm, to revolutionise tramcar traction in this country. When after the expenditure of much money in experimentation, lasting perhaps for many months, electricians gain a knowledge of the laws of traction which competent engineers could have explained to them in as many hours, a scheme is set on foot for employing electricity as a motive power, cars are put in operation and everything goes for a time as merrily as marriage bells. Suddenly the board becomes conscious that all is not right; profits are not coming in, hitches occur with the electrical and mechanical apparatus, the cost of electricity does not work out at the low price which the inventor of the "system" declared to be possible, and it becomes apparent to all that there is a "nigger" in it somewhere. Just at this point the electric launch fad comes right in and for a time the thoughts of those interested in electricity as a motive power are switched off in another direction. This, however, is only temporary, but it appears to be done for a purpose which does not seem difficult to understand. Still those who believe in the possibility in the near future of electricity ousting horses from the position they now occupy in our crowded streets can only regret that money is fruitlessly thrown away and valuable time wasted for no necessary purpose, when every energy should be concentrated upon the one object originally held in view. Street tramways will never be successfully worked by electric locomotion in this country if we do not try to emulate the *nil desperandum* spirit of our American Cousins and stick at the subject with the determination to overcome all obstacles, and at all costs.

THE very interesting apparatus devised by M. Paul la Cour, called the Spectro-Telegraph, is regularly at work every evening in the Copenhagen Exhibtion, and the signals pass quite distinctly at a very fair rate in at one side and out at the other. The distance however is limited to one mile, although M. la Cour has experimented successfully up to 20 or 25 miles. With regard to the Morse code appearing in the Spectro-Telegraphic telescope, it may be of interest to learn that the marks pass before one's eyes in the glass exactly as a slip of paper with the Morse signals pass out of an ordinary instrument, and at the rate of about 20 words a minute, if required. The dots and dashes look white and coloured on a black ground, and one reads them just as easily as if looking on a paper slip. The Danish *savant's* connection with multiplex telegraphy, the practicability of which he was certainly the first to demonstrate, notwithstanding Mr. Delany's assertion to the contrary, was fully brought before the notice of our readers last year, and it is to be hoped that a scientist who has worked so earnestly and successfully in the cause of telegraphy as M. la Cour, may soon meet with a better reward for his untiring labours than has hitherto fallen to his lot; for it seems to us that his latest invention may turn out to be possessed of considerable value for lighthouse and ship signalling at sea.

THE gas engine industry must be a profitable one. Over 20,000 "Otto" motors have already been sold, and this must represent an enormous pecuniary turnover. If the sale which this one type has had in the past goes on in anything like the same proportion, and if the many other kinds of gas engines which are now placed on the market to compete with it gain anything like a fair foothold, the gas engine manufacture promises to become a very important branch of English trade.

WILKE'S Polreagenzpapier is a simple device for indicating positive or negative poles. A little pocket-book contains a number of slips of prepared paper, which can be readily detached as required. When a slip is moistened and the ends of wires connected with any source of electrical energy are placed upon it, one end, the negative, changes to a red colour. Probably the pole indicator of Messrs. Woodhouse and Rawson, which we described some time since, led Mr. Wilke to devise this still more simple arrangement for testing. The pocket-book contains brief instructions respecting the employment of the prepared paper with dynamos; arc lamps; batteries, primary and secondary; telegraph and telephone circuits, and for other purposes; and it appears likely to form not the least valuable part of the testing apparatus of electrical engineers. It would be interesting to know, however, whether the paper loses its virtue in course of time.

THERE are generally two sides to a question, as to a medal, and the so-called stokers' strike at the Grosvenor

Gallery has naturally a reverse to the obverse which was so graphically pourtrayed by Major Waller at the beginning of the month. If the information which has come into our possession is correct, and certain matters which we shall hereafter mention appear to corroborate them, there was no strike at all, and the breakdown at the Grosvenor on that eventful Sunday night must therefore be attributed to other causes, cold roast beef even being held guiltless.

THE stoker who had charge of the boilers on the evening in question had previously spent 14 hours the day before in cleaning out the main flues, and in consequence of a dispute which arose between him and the foreman concerning the water in one of the boilers, the former suggested that he had better resign, and as he was paid by the hour gave an hour's notice, which was accepted in the presence of witnesses. This man knowing that it would be dangerous to leave the boilers without his successor being at hand, asked if he was in readiness to take the vacant position, when the foreman informed him that he need interest himself no further in the matter, and that he himself would accept the responsibility. The dissatisfied stoker was then paid, another man put in charge, and the former left at 7.15 p.m.

THE breakdown, which was caused by an insufficient supply of water and steam, took place, we are assured, between three and four hours after the above occurrence, when everything was left in good working order. The abrupt termination to the stoker's three years' service at the Grosvenor Gallery caused his brother and another man, employed as a trimmer, to resign also, but there were others left to carry out the night's work, some of them being men of long experience. Previous to entering the service of Sir Coutts Lindsay & Co., this man was for 4½ years in the employ of the Great Western Railway Company, and he holds a testimonial, which we have seen, from Mr. John Armstrong, of the locomotive and carriage department, to the effect that during the period named he conducted himself entirely to his employer's satisfaction and left of his own accord, in order, unfortunately as it now turns out for him, to take the place he has so suddenly vacated.

NOW does it not appear on the face of all this that the matter is one of much ado about nothing? On the one hand we have a simple dispute, a resignation followed by one or two others, and payment to two of the three out-going men, who there and then go about their business. Several hours afterwards a casualty occurs, and this, the next day, is magnified by Major Waller into a strike of stokers who refused to eat cold roast beef, which we are now informed was offered to and declined by half-a-dozen men the day previously, and had nothing whatever to do with Sunday.

HAVING now heard both sides of a matter which should never have been given publicity, it seems to us that these men are entitled to some sympathy, and unless it can be shown that we have been grossly misinformed, for the papers and letters in our possession do not point to anything untrue or even evasive, we think that the late stokers of the Grosvenor Gallery are just as much entitled to let the general public hear their version of the famous *contretemps* of June 3rd as was Major Waller. One daily paper, with the largest circulation in the world, has, we understand, declined to publish a letter explaining the case from the men's point of view; but perhaps if it were re-written and signed by all those concerned, instead of, as now, containing but one signature, the issue might be different.

IT must not be forgotten, in the interests of *boná fide* workmen, who have only their weekly earnings to depend upon, and to whom a few weeks of enforced idleness may mean starvation and ruin, that public opinion of the better sort generally inclines towards the employer in any dispute with *employés*. This is quite natural, and, in the majority of cases, we believe it to be justified; but there are instances, and this appears to be one of them, when public opinion should be withheld until both sides have been heard, in order to arrive at a just estimate of the merits of the case. On the assumption that Major Waller's letter contained the real facts of the case, we commented somewhat severely on what we considered very bad conduct on the part of the men; but we shall be much in error if the majority of unbiased thinkers do not now come to the conclusion that the stokers have been made the scapegoat of one of the little bungles which, unfortunately, are neither few nor far between at this West End Central Station.

Our dear old friend the "Eclipse" battery is rising again like a Phœnix from its ashes. First brought out by the "Eclipse" Electric Battery Company, which we suppose went the way of most concerns of the kind, it once again confronts us under the auspices of the "Eclipse" Electric Lighting Syndicate, which seems to us a most unusual course to pursue, and very like putting the cart before the horse. The new prospectus states that the "Eclipse" is acknowledged to be the most simple and effective electric battery that has yet been invented for all purposes. To this we reply that those who are responsible for this statement have wandered considerably outside the paths of rectitude, and we also regret to observe that amongst the press notices which accompany the prospectus, and which are quite familiar to us, not a line is devoted to the comments which we so freely, and without the thought of any future reward, made upon the "Eclipse" some little time ago. In fact, the opinion of the ELECTRICAL REVIEW is entirely left out; an oversight perhaps, but a mishap which is now unfortunately irremediable. The report also of Professor Silvanus P. Thompson is said to accompany the press notices; but the only reference we find to that gentleman is in a reprint from the *Daily Telegraph*, where he is quoted as having written that celebrated letter commencing: "I am pleased, if not amazed, &c., &c." We notice that the capital, which in the old company was £100,000, is now reduced to £20,000 in £1 shares, of which £10,000 in fully paid up shares is taken by the vendor in part payment of the purchase-money; the balance of 10,000 shares being now offered for subscription at par, the vendor to receive £5,000 of this in cash. The name of Sir Charles Clifford is the only one which we notice amongst the four directors as having formed one of the former company's board, the bankers, solicitors, secretary and offices having all been changed. The directors believe they are justified in anticipating that the shareholders will receive large dividends; the German patent has been sold for £1,500; and negotiations for the sale of the patent rights in America have proceeded so far as to lead to the hope that the whole capital of the syndicate may be returned from this source alone, one of the directors being about to proceed to New York to clinch the bargain. We do not know that any good purpose will be served by expatiating further upon a so-called invention which was discussed at great length, both on commercial and technical grounds, in our columns last year, so we take leave of the matter with the parting advice to intending shareholders which our eminent contemporary *Punch* once gave to those about to marry.

THE *Daily News* of Tuesday last is responsible for the statement that it is now within the range of practical science to supersede steam locomotives on the Underground Railway by electrically-propelled engines, and that in October or November next an electric locomotive of 600 horse-power will take its place on the Metropolitan line and fall in with others in the regular train service. There are to be three electro-motors on the locomotive, each independent of the other, and accumulators will provide the electrical energy. We read further that the plant necessary for recharging the accumulators will be provided at the Edgware Road Station, and it is calculated that the operation will be performed in ten minutes. The *Daily News* has no doubt been well posted in this matter, but to recharge secondary batteries in the time stated for a journey of twenty-eight miles, is more than even a technical editor can swallow, and we can therefore only imagine that minutes is a misprint for hours. Has it ever struck the promoters of this wild scheme that the 600 horse-power engine means the employment of 100 tons of batteries, which will entail an expenditure of £6,000, that the discharge necessary for the work will quickly wear out the plates, and that the depreciation on cells alone will amount to nearly as much as the present cost of steam power? Our daily contemporary then goes on to compare the working expenses of steam and electrically-propelled locomotives, but the argument to the detriment of steam is very weak, and altogether misleading, for the article gives one the impression that as much coal is being burnt whether the engine is standing still or doing heavy duty. The confidence of those who think the working of the Underground Railway by electricity to be more or less an accomplished fact, appears to be based upon a contract entered into with the North Metropolitan Tramway Company to work a few cars on the Barking Road tramline by electrically-propelled cars in lieu of horseflesh, and which are shortly to be seen in active operation. It is now nearly a year since this last-named project was put in force, and cars should have been running so long ago as last Christmas. To base such an undertaking as that so eloquently, but fallaciously, put forward by the *Daily News*, on another of a comparatively trivial nature which has not even yet stood the test of time, is a proceeding which no fellow can understand, and it would be interesting to know who inspired our leading Liberal, or shall we say, Radical, journal to take a view of an important matter like this which is at once so opposed to known facts and so illogical in its reasoning. Enthusiasm is all very well in political subjects, and in this branch of journalism our contemporary is, in its way, *facile princeps*, but when dealing with technical points the daily press is usually treading upon dangerous ground, and this instance is certainly no exception to the rule. No one could possibly rejoice more than we should at the advent of electrically-propelled cars on tramlines, or carriages on short lengths of railway, but we do object to the publication of anything which is calculated to cast ridicule upon the whole electrical profession, and the idea of working the underground railway system of the Metropolis by means of secondary batteries—we do not say it is impossible by the conductor method—is of this nature.

WE notice in the last issue of *Industries* a very complete and detailed account of the electric light installation at Leamington. The article in question describes, with no measured praise, the success of the undertaking, and deprecates the criticism to which the "system" has been subjected by a technical journal which shall be nameless. Now we are quite prepared to accept, on our contemporary's authority, the statement that the illumination of shops and private houses has given every satisfaction, but if eye witnesses and the local papers are to be believed, the street lighting has turned out a most decided failure. Our contemporary may be perfectly correct in stating that the complaints as to the inefficiency of the light, proceed from certain parties merely because their political opponents take a different and favourable view of the matter, but this argument could, with perhaps equal justice, be applied the other way. It is remarked that the lighting was carried on up to Christmas 1887 "experimentally," and since that date the regular service has been in operation. From the reports of the meetings of the Municipal authorities, it would seem to us that so far from the experimental stage being concluded, an extension of time has been granted so as to reduce the "experiment" to a practical stage.

IT will be to some extent gratifying to our readers to learn that the medical profession is at length awakening to its responsibilities and recognising that it may do something to mitigate the evil represented by the advertising electro-medical quack. We have it upon good authority that the Medical Defence Union is contemplating the prosecution of Mr. C. B. Harness for the illegal assumption of the title of "Dr." We hope the Medical Defence Union will see its way to pushing the matter to the utmost, for the proceedings of this person have become nothing short of a scandal to the whole medical profession. The only fear we have is, that in such an action as that of prosecution for the wrongful assumption of a medical title, the issues will be so simple that the real character of the man and the trade he does will not fully appear. The one thing needed is to attract the attention of the non-professional public and demonstrate to them what manner of man is this pretentious individual. Harness claims to be a medical man and an electrician, an "eminent electrician," in fact; he is in reality a man endowed with exceptional talents of a commercial order, which, allied with a little right principle, and perhaps also a little education, might have enabled him to reach an enviable position in legitimate business circles. He has, however, chosen another path, and has been perhaps unprecedentedly successful. Some years ago he exploited an "electrical brush" ("Dr. Scott's"). This seems to have been his first connection with "electricity," and from this connection has sprung the present gigantic trade in so-called electro-medical appliances. Such is the man who claims to be a competent person to advise sufferers upon medical questions of a most delicate and difficult nature.

THE MAXIMUM EFFICIENCY OF ELECTRIC LAMPS.

ON the 10th April last, a paper by Mr. John W. Howell was read at the American Institute of Electrical Engineers, which gives to the world some interesting results, obtained by a number of very lengthy experiments, with regard to the life of incandescent lamps of the Edison type made with "unflashed" bamboo filaments, and run at different efficiencies. He also enters into the very important question of the "maximum efficiency" at which lamps should be run in practice, under different conditions of cost of current, lamps, and quality of lamps, and obtains from his calculations an almost definite ratio between the cost of current and of lamps, even when the three regulating conditions are varied to a very considerable extent. Everyone is naturally aware that when the cost of current is high, and that of the lamps is low, and withal good in quality, it is desirable to run them at high incandescence; and that when the lamps are dear and bad, and the current cheap, high incandescence is not desirable. But Mr. Howell informs us clearly and distinctly of a simple and definite ratio existing between the cost of lamps and the total cost when this latter is a minimum, and by recognising this ratio, we may know that we are running our lamps at their maximum efficiency. This is of course not the first time that this question of maximum efficiency has been dealt with, but we do not remember having hitherto seen the subject handled in such a clear and practical manner as in this paper.

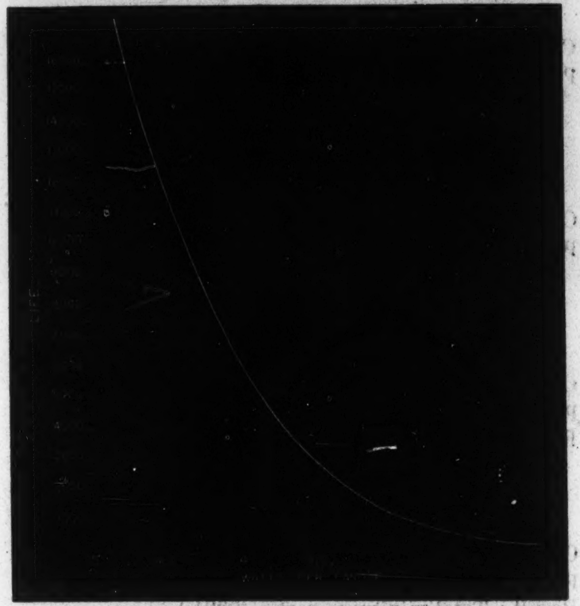
Mr. Howell commences by defining the terms "efficiency" and "maximum efficiency" which are used throughout his paper. The former is used in the ordinary popular sense of watts per candle; but he argues that it is incorrect, because no account is taken of the heat. The latter expression he defines as "the efficiency at which the cost of operating the lamp is a minimum." This efficiency, he proceeds to explain, is not the highest attainable from a lamp, but includes its quality and cost. With regard to this term "maximum efficiency," we would remark that it would be more applicable for defining the efficiency of a certain installation, as the cost of the current forms an essential element.

The first step necessary in ascertaining this maximum efficiency, which we all desire to know, is to find out the quality of the lamps we are using. The average quality of a certain class of lamp run at different efficiencies is a very difficult problem to determine, and runs, as Mr. Upton put it in the discussion, into very difficult and expensive experiment. The Edison Company of America have only lately settled this point with regard to their lamps, by careful experiments extending over no less than five years. The following figure shows the life curve between 2 and 5 watts per candle. This curve naturally does not apply to any particular lamp of its class, but to the average. Mr. Howell also informs us that it does not hold good for lamps whose filaments have been subjected to "flashing," in which we in England are more interested, but only to the bamboo filaments.

We are next brought to the data necessary to calculate the maximum efficiency at which to run our lamps. These are—1st, the cost of the current, which comprises every item entailed in its production and delivery; 2nd, the cost of the lamps; 3rd, the life of the particular class of lamp in use at different efficiencies.

In order to determine when the cost of operating lamps is a minimum, or, in other words, when the lamps are running at a maximum efficiency, it is necessary to calculate by the two different formulæ given below, the cost of the currrent, and the cost of the lamps, at different efficiencies. By this means two series of figures are obtained, one set representing the cost of current, which decreases as the efficiency is raised, the other set the cost of the lamps, which increases as the efficiency is raised. By adding together the cost of current and of lamps at each different efficiency, a certain point is reached where the total cost is a minimum, and this particular efficiency will be the maximum one at which the lamps should be run under the given conditions.

Curve showing lives of equally good lamps, burned at different efficiencies.



In a number of cases which follow, Mr. Howell calculates the cost of operating 100 16-C.P. lamps run for 1,000 hours, but he varies the cost of the current between 2·5 cents and 10 cents per H.P.; the cost of the lamps between 25 cents and $1 each; and the quality of the lamps at a life of 300 and 2,400 hours when run at 3 watts per candle. He seems to assume, moreover, that whether a set of lamps last 300 or 2,400 hours, or any number between these figures when running at 3 watts per candle, that at different efficiencies each set will follow the same curve. This course may perhaps be justified to bring out the practical issue of the paper, but no proof of the assumption is given.

The formulæ are:

$$\text{Cost of current} = \frac{\text{watts per C.} \times 16 \times 100 \times 1000 \times \text{cost of current per H.P.}}{746}$$

$$\text{Cost of lamps} = \frac{\text{cost of one lamp} \times 100 \times 1000}{\text{life at given watts per candle}}$$

Example I.—Conditions: Lamps 85 cents each. Current 10 cents per H.P. Life 600 hours at 3 watts per candle.

$$\text{Result: }\left.\begin{array}{l}\text{Total minimum cost} = \$783\\ \text{Cost of lamps} \;\ldots\; = \$113\end{array}\right\}\text{ ratio } \cdot145 : 1$$

Maximum efficiency = 3·1 watts per candle.

Example II.—Conditions: Lamps $1 each. Current 10 cents per H.P. Life 600 hours at 3 watts per candle.

$$\text{Result: }\left.\begin{array}{l}\text{Total minimum cost} = \$800\\ \text{Cost of lamps} \;\ldots\; = \$118\end{array}\right\}\text{ ratio} = \cdot147 : 1$$

Maximum efficiency = 3·18 watts per candle.

Example III.—Conditions: Lamps $1 each. Current 5 cents per H.P. Life 600 hours at 3 watts per candle.

$$\text{Result: }\left.\begin{array}{l}\text{Total minimum cost} = \$444\\ \text{Cost of lamps} \;\ldots\; = \$68\ 9\end{array}\right\}\text{ ratio } \cdot155 : 1$$

Maximum efficiency = 3·5 watts per candle.

Example IV.—Conditions: Lamps $1 each. Current 2·5 cents per H.P. Life 300 hours at 3 watts per candle.

$$\text{Result: }\left.\begin{array}{l}\text{Total minimum cost} = \$273\\ \text{Cost of lamps} \;\ldots\; = \$41\end{array}\right\}\text{ ratio } \cdot154 : 1$$

Maximum efficiency = 4·32 watts per candle.

Example V.—Conditions: Lamps 50 cents each. Current 10 cents per H.P. Life 1,200 hours at 3 watts per candle.

$$\text{Result: } \left.\begin{array}{l}\text{Total minimum cost} = \$654\\ \text{Cost of lamps} \;\ldots\; = \$92\end{array}\right\}\text{ ratio ·14 : 1}$$

Maximum efficiency = 2·62 watts per candle.

Example VI.—Conditions: Lamps 50 cents each. Current 5 cents per H.P. Life 1,200 hours at 3 watts per candle.

$$\text{Result: } \left.\begin{array}{l}\text{Total minimum cost} = \$362\\ \text{Cost of lamps} \;\ldots\; = \$53\end{array}\right\}\text{ ·146 : 1.}$$

Maximum efficiency = 2·875 watts per candle.

Example VII.—Conditions: Lamps 50 cents each. Currents 10 cents per H.P. Life 600 hours at 3 watts per candle.

$$\text{Result: } \left.\begin{array}{l}\text{Total minimum cost} = \$728\\ \text{Cost of lamps} \;\ldots\; = \$107\end{array}\right\}\text{ ratio ·146.}$$

Maximum efficiency = 2·88 watts per candle.

Example VIII.—Conditions: Lamps 50 cents each. Current 5 cents per H.P. Life 600 hours at 3 watts per candle.

$$\text{Result: } \left.\begin{array}{l}\text{Total minimum cost} = \$400\\ \text{Cost of lamps} \;\ldots\; = \$60\end{array}\right\}\text{ ratio = ·15 : 1.}$$

Maximum efficiency = 3·175 watts per candle.

Example IX.—Conditions: Lamps 25 cents each. Current 5 cents per H.P. Life 2,400 hours at 3 watts per candle.

$$\text{Result: } \left.\begin{array}{l}\text{Total minimum cost} = \$294\\ \text{Cost of lamps} \;\ldots\; = \$41\end{array}\right\}\text{ ratio ·14 : 1.}$$

Maximum efficiency = 2·38 watts per candle.

Example X.—Conditions: Lamps 25 cents. Current 10 cents per H.P. Life 2,400 hours at 3 watts per candle.

$$\text{Result: } \left.\begin{array}{l}\text{Total minimum cost} = \$535\\ \text{Cost of lamps} \;\ldots\; = \$81\end{array}\right\}\text{ ratio ·151 : 1.}$$

Maximum efficiency = 2·14 watts per candle.

Example XI.—Conditions: Lamps 25 cents each. Currents 5 cents per H.P. Life 1,200 hours at 3 watts per candle.

$$\text{Result: } \left.\begin{array}{l}\text{Total minimum cost} = \$327\\ \text{Cost of lamps} \;\ldots\; = \$47\end{array}\right\}\text{ ratio ·143 : 1.}$$

Maximum efficiency = 2·62 watts per candle.

By drawing curves of the total cost at different efficiences, it can be seen at a glance that where the current is expensive the lamps must be carefully selected, as small changes in efficiency from the maximum causes a considerable augmentation in the total cost. Conversely, where the current is cheap considerable variation in the efficiency of the lamps makes but a slight addition to the total cost.

But the most interesting and important result of these calculations is, that there is always a ratio of about 15 per cent. between the cost of lamps and the total cost in all the above cases, where the conditions of cost differ so widely. The figure varies slightly in individual cases, but the variations do not appear to conform to any law. The practical outcome of the calculations is, therefore, that if we have an electric light installation and wish to know whether we are running our lamps at the maximum efficiency, all we have to do is to subtract from our total expenses the cost of the lamps and see if the bills amount to 15 per cent. of the whole. Attention is drawn to the fact that when the lamp bill in any particular installation is not 15 per cent. of the total, *e.g.*, let us say 10 per cent., it must not be raised to that point by altering the efficiency of the lamps then installed and so increasing their consumption, for this would effect an increase in their candle-power; but it should be done by changing the lamps so as to obtain the same amount of light but at a higher efficiency. What would, of course, come to the same thing would be to run the same lamps at a higher efficiency, but to decrease their number, and this, we take it, would be the simplest plan.

With regard to the proportion which the consumption of lamps should bear to the total, we would remark that in a paper by Dr. J. A. Fleming on "The Characteristic Curves and Surfaces of Incandescent lamps," read at the Physical Society, on March 14th, 1885, the same question was dealt with, but on entirely different lines. We note, on referring to this paper, that Prof. Fleming calculates that the lamps should be run at such a pressure as to come to 17·4 per cent. of the total cost. In the concluding paragraph mention is made, that in consequence of experiments conducted by the Edison Company, of America, they were at that period (1885) in the habit of recommending that the lamp cost should come to 16 per cent. of the total, but now Mr. Howell informs us that it should be somewhat lower still.

In the discussion which followed the paper, Mr. Mailloux called attention to the fact that it is a property with incandescent lamps, like everything else in nature, to grow old and weary, and he asked whether the lives in the curves which were shown represented the time when the filaments broke, or when the lamps became so dim as to be useless. He had some difficulty in obtaining an answer, but at length we understand Mr. Howell to admit, that when the lamps arrived at "the point at which they became useless," they were counted as dead. From this remark it would appear to us that a rather arbitrary method of regulating the lives of the lamps had been employed in the life tests, and about on a par with what would happen in practice, viz., that the lamps would last in the direct proportion to the easy going and contented nature of the consumer. We should have thought that it would have been found desirable to fix upon a definite loss of light for each lamp, at which point it should have been discarded, but even if some such method had been adopted, we cannot get over the fact that any experimental life tests at different efficiencies must always be more or less erroneous on the score of the gradual dimming of the lamps which results from increase of resistance, increase of surface, and blackening of the bulbs. In other words the results are always shown in a more favourable light than is actually their due. In stating this, we are perfectly aware that all tests are necessarily equally erroneous, for lamps manufactured by different methods do not all blacken or change in resistance or surface in the same degree, but we have never come across one that remained entirely unaltered.

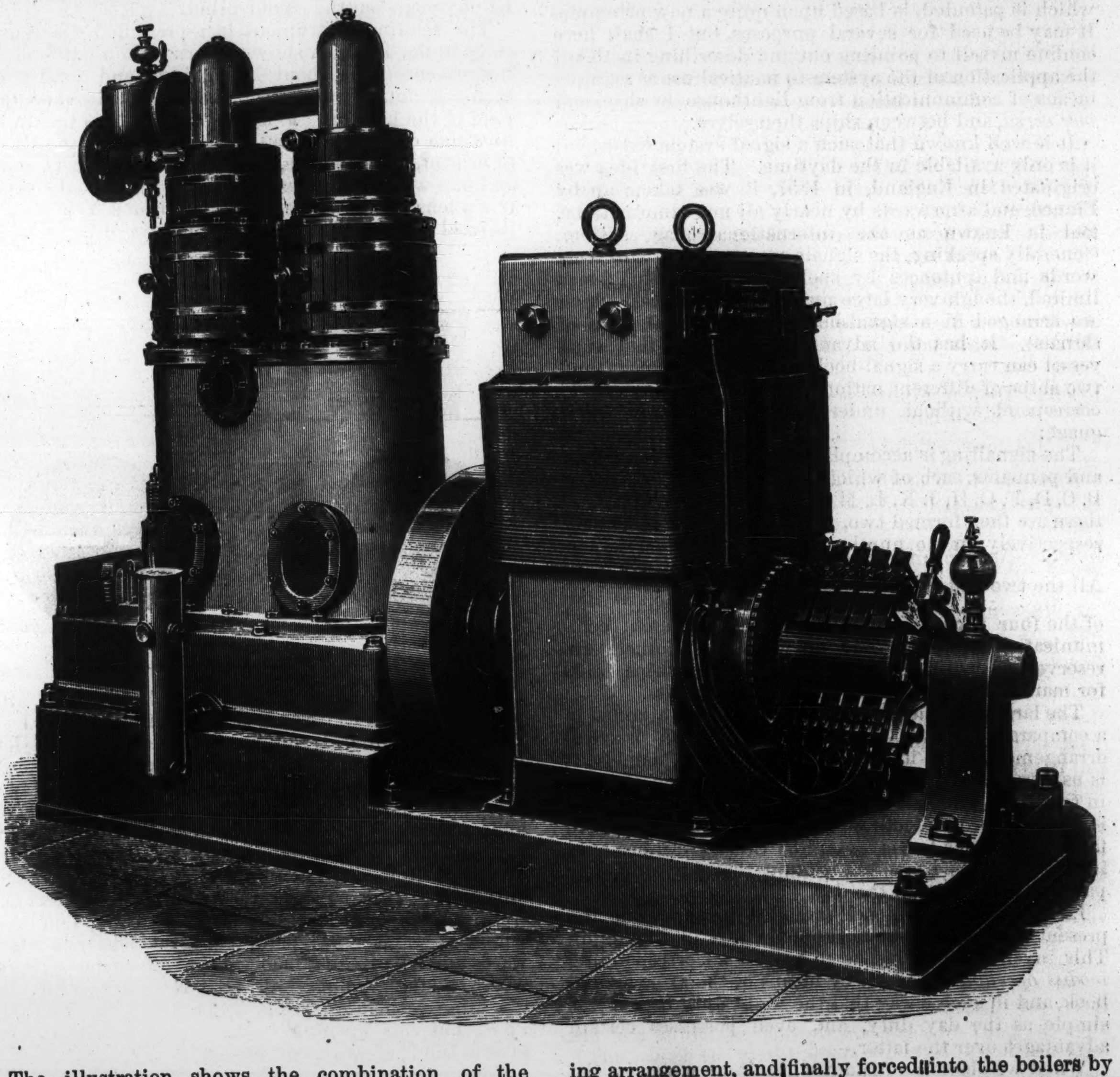
The query was also started as to whether there was a mathematical expression for the life curve, and one speaker thought it looked like a hyperbola, but Mr. Howell stated that it was not a hyperbola or any other curve that had a name. He had had a mathematical man to devote about a week in trying to handle it, which resulted in obtaining "an expression for it which goes all the way across a sheet of paper."

The question was also raised as to the effect of alternating *versus* continuous currents on the life of lamps, and cases were cited in favour of both descriptions of electric energy, but Mr. Howell was inclined to the opinion that the differences which had been observed lay entirely in the method of handling the installations. Life test comparisons, he very correctly stated, were exceedingly difficult to make with any degree of accuracy and it was the hardest thing he had ever undertaken. In the efficiency life curve he produced, the lamps were run off a dynamo, and a man was continuously in charge to do nothing else but to keep the pressure constant. In connection with this point of direct *versus* alternating currents, we may mention that Profs. Ayrton and Perry have quite recently endeavoured to ascertain whether any difference could be detected in the efficiency or watts per candle, and apart from life, by these methods of running lamps, and they have come to the conclusion that the minute differences which were observed, were within experimental error, and that "the efficiency of an incandescent lamp is the same for both direct and alternating currents."

THE HOLMES-WILLANS SYSTEM.

WE recently inspected the engine-room at the Tottenham Court Road establishment of Messrs. Maple & Co., where Messrs. J. H. Holmes & Co., of Newcastle and London, have installed some of their own dynamos coupled to Willans engines. The room, which is a model of its kind, is only 28 feet × 18, and will, when complete, contain four sets of combined engines and dynamos.

There are two sets already in position, each taking a a floor space of 9 feet × 3, and we must confess that we were mightily pleased with their compact design, which is a fine example of competent mechanical and electrical engineering skill.



The illustration shows the combination of the Holmes-Willans system, and represents a 38 kilowatt compound-wound dynamo driven direct by a Willans compound engine running at 450 revolutions per minute, and giving 112 volts and 340 ampères. The field magnets are entirely of massive soft iron forgings, machined and polished all over. The armature core is positively driven by an arrangement which secures great mechanical strength and rigidity with a maximum of available space inside for conductor and ventilation. The conductor of laminated copper is positively driven on the outside of the core, thus obviating the danger of the conductor moving on the core, a fault so common to machines with intense fields. The brushholders are conveniently adjustable both as to pressure, which is along the line of the brush, which consequently always wears at the same angle, and also longitudinally on their spindle, so that any possible wear of the commutator may be equalised. The connections, which are very massive, are so arranged that half of the field magnet can be removed without disconnecting any but the flexible leads from the brushes. The electrical efficiency from actual tests works out 95·72 per cent., absorbing 55 brake horse-power.

One of these plants has been running 12 hours per day since November, 1887, at Messrs. Maple & Co.'s, Tottenham Court Road; and a second similar plant, as mentioned previously, has just been supplied to them.

The boiler-house contains three 30 horse-power nominal loco type boilers by R. Hornsby and Sons, the water for which is first filtered by Maignen's anti-calcaire *filtre rapide*, then heated by Rayner's feed-water heating arrangement, and finally forced into the boilers by Worthington's patent pumps.

The wiring of the establishment has been done by Messrs. Maple's own *employés*, supervised by Mr. Wm. A. Buckland, who was specially engaged to advise on technical points. So it will be understood that the connection of Messrs. Holmes & Co. with the installation begins and ends with the engine-room and boiler-house. The total number of lamps to be employed is no less than 2,400, and the combined generating plant, which appears to require but little attention, is in charge of Mr. Usher, who is also one of Messrs. Maple's hands, and who seems to have completely mastered the technics of electric lighting.

It is but rarely that one sees an installation which may be taken as a model for future plants, and we have therefore all the more pleasure in making favourable mention of the arrangements at Messrs. Maple's, which are well worth going a long way to view; and, what is more, Mr. L. W. Holmes, who represents the firm in London, is not averse to showing it and explaining all its details to those who are genuinely interested in electric lighting.

SPECTRO-TELEGRAPHY.*

SPECTRO-telegraphy is the name of a new invention by Paul la Cour, the inventor of the phonic wheel, and its synchronism for multiplex telegraphy. The instruments are shown at work at the present moment in the Copenhagen Industrial Exhibition, and the invention, which is patented, is based upon quite a new principle. It may be used for several purposes, but I shall here confine myself to pointing out and describing in detail the application of the system to nautical use as a simple means of communication from lighthouse to ship, and *vice versâ*, and between ships themselves.

It is well known that such a signal system exists, but it is only available in the daytime. The first idea was originated in England, in 1857, it was taken up by France, and afterwards by nearly all maritime nations, and is known as the international flag system. Generally speaking, the signals are not meant to express words and sentences by spelling, but only to give a limited, though very large number of sentences, which are arranged in a signal-book (international code of signals). It has the advantage, however, that each vessel can carry a signal-book in its own language, and two ships of different nationalities are thus enabled to correspond without understanding each other's language.

The signalling is accomplished by means of 18 flags and pennants, each of which indicates one of the letters, B, C, D, F, G, H, J, K, L, M, N, P, Q, R, S, T, V, W. Of these are then formed two, three, or four-flags signals, respectively, in the number of 306, 4,896, and 73,440. All the two and three-flags signals and the $\frac{2}{18,960}$ $\frac{1}{\text{first}}$ of the four flags are intended for the different communications, queries, and answers. The others are reserved as "distinguishing signals" for ships, 1,440 for man-of-war, and 53,040 for trading vessels.

The large extension which this system has attained in a comparatively short period is a proof of its practical arrangement; still it has one disadvantage, namely, it is useless at night, and yet ships sail as much then as in the day. The value of this mode of correspondence is thus reduced one-half, and an owner wishing to give final instructions to his captain by this means, hesitates in doing so, as he is not certain that his ship may pass the lighthouse in the day.

La Cour's system is not intended to supersede the present flag system, but to supplement it in the night. This invention enables us to utilise a corresponding *modus operandi* at night by means of the same signal-book, and in such a way that the night duty becomes as simple as the day duty, and even possesses certain advantages over the latter.

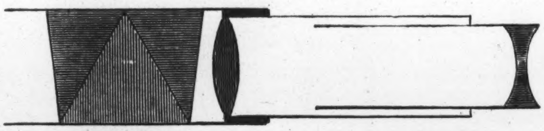
When we observe a distant white light, a star, or the light from a lighthouse through a prism with vertical edge, then such a light, as is well known, appears as a horizontal luminous line, consisting of red, orange, yellow, green, blue, indigo and violet-coloured rays. Sir Isaac Newton discovered that this was owing to the fact that the white light in reality is a combination of all these colours, with their infinitely many shades, and that they are refracted differently in the prism and thus separated, whilst they can again be combined and reproduce the white light.

Instead of a simple, a compound prism may be used. The latter separates the colour rays, but does not, on the whole, deflect them much from their original direction, and such a prism fixed on a telescope (fig. 1) is specially adapted to dissolve the in-going light. When a distant *white* spot of light is observed through this, a luminous line (fig. 2) is seen in the field of the telescope, *coloured from red to violet.*

If now the person *who is sending* the light signal is capable of providing, in a simple manner, that all the colour rays are not emitted, but only some, while others are entirely removed, it can be arranged so that the remaining part of the spectrum appears as a distinct signal, for instance the Morse signal - - —— (fig. 3). This is exceedingly easy to decipher, and does not even require colour sense, for although it is differently coloured, yet it is only the shape which is of importance (the colours are only the means of providing the conventional shape), and the signal can be made by anyone, even the colour blind.

The sending instrument is represented diagramatically in fig. 4, which shows a horizontal section of the instrument (it is about 1 foot high and long and 8 inches wide), together with the rays of light on their road to the horizon. F is the lamp, S, K is the screen, in which openings are cut corresponding to the signals to be sent, for instance, two small openings (1 and 2) and one wide (3), corresponding to the signal - - ——. L is a lens, the distance of which from S, K is equal to its focal length. Therefore all the rays of light, which through the opening, 1, strike the lens, L, will, after passing through it, become parallel with the line, 1—0, from the opening, 1, to the optical centre of the lens (0). The other rays of light are therefore not shown, for they have the same direction as 1—0. This ray of light will then strike the prism, P, and be refracted and spread, so that it forms the coloured; fan-shaped rays of light, r_1, v_1, containing all the colours. In the direction of the distant observer, *i*, a distinct colour only will be emitted from the opening, 1, say *orange*; from the opening, 2, there will also be rays emitted, which are first made parallel by the lens, and afterwards spread by the prism in the fan-shape r_2, v_2, of which a single colour only strikes *i*, say *yellow*. In the same way the opening, 3, produces the fan-shape r_3, v_3, but this opening being wider, *i* will receive several kinds of *green* and *blue* rays.

FIG. 1.



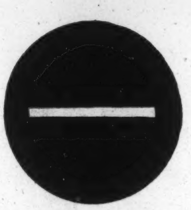


FIG. 2.

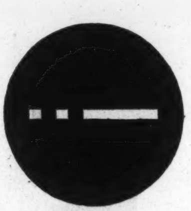


FIG. 3.

To the naked eye, or with an ordinary telescope, the light which issues in the direction *i*, will give shades of colour corresponding to a mixture of the respective colours; but if the spectro-telegraphic telescope is used, the signal appears as in fig. 3.

When the sender moves the screen, S, K, in the direction indicated by the arrow, opening 3 will take opening 2's place, opening 2 takes 1's place, and in the field of the telescope the receiver will also see the line of light, 3, slide smoothly into 2's place, &c., &c., so that the signals are seen to glide through the field, in at one side and out at the other.

To perfect the present system of signalling, and use la Cour's signals at night, a sending instrument, with the 18 perforated metal pieces, together with the receiving telescope is only required. Instead of hoisting the four flags in the daytime, signifying, for instance, C, F, G, L, the four corresponding pieces of metal need only be inserted in the sending lantern, and made to move backwards and forwards several times, so that the receiver has time to read them.

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* Translated from the Danish. Communicated by Mr. P. Chr. Dresing.

These night signals are in some respects superior to the day signals. They are, for example, not diminished by distance, as their size only depends upon the receiving telescope, so that however far they are sent they keep the same dimensions. They are also independent of the direction of the wind, which often disturbs the flag signals by making them turn edgeways to the observer so that he cannot see them.

This same system has been tried for ordinary telegraphy, by passing a perforated slip (as in the Wheatstone's transmitter) through the sending instrument, and a telegraphist can read these marks so easily, that the telegraphing can be performed with the same speed as with an ordinary Morse instrument.

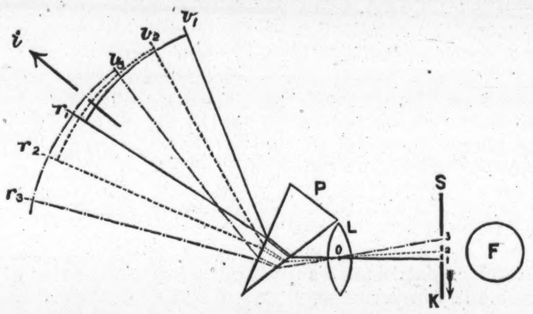

FIG. 4.

It is well-known that a hazy atmosphere first obliterates the violet and blue rays of light; it has therefore been supposed by some that spectro-telegraphy would fail under these circumstances. This is, however, not so, for as the signals seem to glide through the whole spectrum, they can always be read in the red, yellow, and green, even if they are lost in the violet and blue.

This principle also appears to be applicable in several different ways. If a lighthouse is supplied with a sending instrument, in which the first letter or letters of the light's name are placed, the mariner will always be able to see in the spectro-telegraphic telescope what light it is, and thus mistakes and loss may often be prevented.

Further, an entrance to a harbour does not need to be indicated by *two* lights, which direct the course, but by *one* only of La Cour's system, with a fixed signal or letter, which is only seen in the middle of one's telescope, if one is exactly on the right track. By steering a little to the one side or the other, the letter or signal will appear to glide in the telescope to either of the two sides, and if the ship passes entirely out of the proper course the signal disappears from the field of the telescope. Another advantage in this method is, that the light from the harbour lantern is very easily distinguished from all other lights, for these latter appear in the telescope as a continuous light from red to violet, whereas the former gives its own peculiar signal, for example - —— - ——.

Finally, ships might be supplied with a fixed lantern of this kind, which throws light forward, and obliquely to the sides. Two ships going in opposite directions will thus in their telescopes immediately see whether their course lies to the starboard or port of each other, and also whether they are in the act of altering their helms, for the letters in the telescope will then appear to glide to one side or the other.

NOTES FROM GERMANY AND AUSTRIA.

THE *Berliner Elektricitatswerke* states that the new scale of charges for the electric light in Berlin, fixed by the magistrates, is as follows:—The annual tax for a current feeding upwards of 10 incandescent lamps of 16 candle-power, 15s.; from 10 to 25 lamps, 20s.; from 25 to 50 lamps, 30s.; from 50 to 100 lamps, 40s.; from 100 to 200 lamps, 50s.; from 200 to 400 lamps, 75s.; and for upwards of 600 lamps, 100s. In addition a fee of 6s. a year is paid for the use of each incandescent lamp. For the current to each arc lamp a sum of 40s. is paid annually, whilst on lamps used from 800 to 3,000 hours a year a discount varying from 5 to 25 per cent. is allowed.

The largest hydraulic and electrical central station in Germany has just been opened in the so-called "free harbour" at Hamburg. With a pressure of 50 atmospheres the hydraulic central station is capable of working 36 cranes, 250 winches, and 50 elevators, whilst the electric dynamo machines are capable of feeding 4,200 incandescent and 50 arc lamps. The cost of the station is £150,000.

In Hamburg, too, the electric light has for the first time been introduced into private houses, the chief of the well-known firm of financiers, Messrs. Behreun and Sons leading the way, and several other wealthy merchants intend to do the same.

In the city of Lubeck the electric light is now for the first time being tried for lighting the streets, the plant for the same having been supplied by Herr S. Schuckert, of Nuremberg. At first only the principal street in the city, the Breitenstrasse, and a few adjacent ones will be thus favoured, the light being supplied by about 1,000 incandescent lamps. During the first four weeks the lights will be put out at 3 a.m. Besides the incandescent lamps a few arc lamps will also be tried. The dynamos used are capable of supplying about 4,000 lamps.

As regards the extended use of the electric light in Germany, it may be of interest to mention that in addition to the four central stations already at work in Berlin, a fifth is in course of erection in the Spandon Strasse. There are now nightly burning in the German capital 30,000 glow lamps and 2,000 arc lamps. Recently, too, the Royal Opera House has been fitted with the electric light, which is now being tried, 4,000 glow lamps being used. Whilst in order to make the house thoroughly safe as regards an explosion, electricity is also used in the dressing and other rooms for warming, boiling water, heating, hairdressing apparatus, &c. The opera house is worked from the central station in the Markgrafeustrasse through 80 special cables. The electric light is also shortly to be introduced for lighting the famous promenade "Unter den Linden."

The light is also being tried for marine purposes in Germany, and with great success. Thus recently the great lighthouse at Neufahrwasser, outside Danzig, has been fitted with the light, being the first beacon in Germany and the Baltic thus lighted. Experimentally the lamp is placed on a wooden platform 7 metres above the cupola, and the light may be seen within a radius of 16 English miles. Furthermore, the light is being introduced into the German navy, four of the largest ironclads being now provided with it. Thus the *Princess Irene* has been fitted with 52 incandescent lamps, and with three position lamps, the latter of 50 candle-power, whilst the *Princess William*, *Bavaria* and *Wacht* are also being provided with the light.

The use of the telephone is also becoming more and more general in Germany, and a new line has just been laid between Berlin and Hamburg. One was already being worked, but of late the demand has become so great that another had to be laid. On the other hand, the Belgian Government has proposed to the German to open negotiations for the laying of a telephone between Brussels, Aix-la-Chapelle and Cologne.

From the report just issued of the working of the telegraph system of Germany in 1887, it appears that the length of the lines had risen from 71,617 kilometres in 1886 to 74,690 kilometres in 1887, and the length of the wires from 252,453 to 261,380 kilometres. The number of telegraph stations in the Empire was 8,841, that of attendants 4,062. There were 16,596 telegraph apparatus in use. The number of messages dispatched amounted to 18,000,000, being 7·25 per cent. more than in the previous year. Whilst formerly the messages were shortened year by year, the average number of words transmitted in 1887 rose to 11·81, against 11·65 in 1886, an increase attributed to the new minimum rate of charge imposed. The gross receipts on telegrams were £1,030,000. The government telephones also show progress. Thus, at the end of the year there were telephones in 113 towns, with 20,000 subscribers, whilst the number of messages rose from 39,000,000 in 1886 to 65,000,000 in 1887. The number of telegraph stations fitted with the telephone rose from 3,170 to 3,730.

The electric light is also making good progress in Austria, and recently the Opera house in Vienna has been fitted with it, and with such success that it has been decided also to introduce it into several other theatres and public buildings. At the Opera house the current is supplied from a station one mile distant, and the plant here is capable of supplying 20,000 lamps. Four subterranean cables work the lamps, the electricity being stored in accumulators. Below the stage is a current division table for the lamps on the stage. The former gas plant has, as far as possible, been used for the electric one. In order to vary the power of the lamps on the stage a new kind of resistance rollers of spirally-coiled platinum wire have been introduced, which, in order to keep them cool, are placed in oil surrounded by water.

WHAT IS THE SPECIFIC RESISTANCE OF COPPER?

IT is sometimes important to know the true resistance of pure copper, writes George B. Prescott, jun., in the New York *Electrical Engineer*, and everyone who has had recourse to the text-books for the purpose of ascertaining the specific value is aware that not only are the figures given in various abitrary and inconvenient units, but has discovered, moreover, that if reduced to a common standard the values are discordant. In many cases no authority for the value used is mentioned, and in every instance where one is given, so far as my knowledge goes, it is attributed either to Matthiessen or to Jenkin, who merely tabulated the results of Matthiessen's experiments.

Now, as Dr. Matthiessen conducted his experiments while a member of the committee of the British Association, which was appointed to determine upon a practical standard unit of resistance, the report of that committee* ought to give, authoritatively, the value of Matthiessen's determination. It seems, however, that Dr. Matthiessen devoted himself more particularly to ascertaining the permanency and relative resistances of the metals and alloys than to determining their specific resistance; so that, oddly enough, throughout the six reports made by the committee the only reference made to the absolute resistance of any of the metals or alloys is found in the third report, in a table showing the relative values of the proposed units of resistance. In this table the unit proposed by Matthiessen is *one English standard mile of pure annealed copper wire* $\frac{1}{16}$*th inch in diameter at* 15·5° *C., and having a resistance equal to* 13·59 *B.A. ohms*. This specific value for the resistance of copper has been extensively adopted, and is the basis of a table of the properties of copper wire by the writer, published in the *Electrician and Electrical Engineer* four years ago, and also of the tables of the British Board of Trade and American standard gauges, which have since been promulgated.

In later tables more precise and scientific definitions of units and specific values have been employed, and specific resistance is now usually expressed in legal microhms between opposite faces of a centimetre cube or cubic inch of the material at 0° C. Happening to compare the tables of specific resistances which are published in the two recent and excellent text books by Prof. Ayrton and by Profs. Stewart and Gee, respectively, I observed that even they did not agree in their value for copper. Ayrton gives the specific resistance of pure annealed copper at 0° C. as

1·599 legal microhms per cubic centimetre =
·6292 ,, ,, ,, ,, inch.

While Stewart and Gee give the values as

1·616 legal microhms per cubic centimetre =
·6357 ,, ,, ,, ,, inch.

On looking further through a large number of electrical text-books and pocket-books I found in the majority of cases that the specific resistance of pure copper was given as 9·718 B.A. ohms for a wire one foot long and $\frac{1}{1000}$th of an inch in diameter at 0° C.

In the report of the British Association committee there is published, as an appendix, a series of "Cantor Lectures" on the subject of "Submarine Telegraphy," by Fleeming Jenkin. In the fourth lecture is a table of the specific resistances of metals and alloys calculated from Matthiessen's experiments, giving the values in foot-mils, foot-grains, &c., and this is the table which has been so extensively copied in most of the text-books. Correcting Matthiessen's standard mile unit to the foot-mil dimensions as given by Jenkin gives

$$\text{1 foot mil at } 15{\cdot}5^\circ \text{ C.} = \frac{13{\cdot}59 \times 62{\cdot}5^2}{5280} = 10{\cdot}054 \text{ B.A. ohms.}$$

Using Dr. Matthiessen's formula to correct for the difference in temperature, viz.:

$$\text{R} = r\,(1 + a\,t + b\,t^2).$$

In which R = the resistance at required temperature.
r = ,, ,, ,, given ,,
a = a constant number = + ·003824.
b = a ,, ,, = + ·00000126.
t = the number of degrees difference between the two temperatures, then

$$\text{R} = \frac{10{\cdot}054}{1 + ({\cdot}003824 \times 15{\cdot}5) + ({\cdot}00000126 \times 15{\cdot}5^2)}$$
$$= 9{\cdot}49 \text{ B.A. ohms at } 0^\circ \text{ C.}$$

From which it follows that Jenkin's value is about 2·3 per cent. higher than Matthiessen's standard.

In order to fully understand the differences which exist in the published values of the specific resistance of pure annealed copper wire, it will be conveneint to reduce the figures given above to the legal ohm and cubic inch units, assuming that one B.A. unit = ·9889 legal ohms. Then Jenkin's standard

$$= \frac{9{\cdot}718 \times {\cdot}9889 \times {\cdot}7854}{12 \times 1000^2} = {\cdot}629 \text{ legal microhms}$$

per cubic inch, and Matthiessen's standard

$$= \frac{9{\cdot}49 \times {\cdot}9889 \times {\cdot}7854}{12 \times 1000^2} = {\cdot}6142 \text{ legal microhms per}$$

cubic inch.

It will thus be seen that Professor Ayrton and the majority of authors have accepted Jenkin's calculations, and that in standard wire tables Matthiessen's own unit has been taken as a basis; while Stewart and Gee, who state no authority, have a figure even higher than Jenkin's. Kohlrausch, I believe, quotes Matthiessen with even a lower figure than that given here, while intermediate values are to be found here and there.

The difference between the two references in the B.A. report will probably account for much of the confusion as to Matthiessen's value for the specific resistance of copper, particularly as both are attributed to him. I am inclined to think the lower figure nearer the true one, as it agrees more closely with the results of my own measurements.

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* Edited by Fleeming Jenkin, and published in 1873.

THE INSULATION OF MAINS FOR HIGH TENSIONS.

By G. L. ADDENBROOKE.

IV.

IN concluding the last article it was recommended that conductors to carry high tension currents should be covered with layers of pure "zinc" and "compound or black" rubber of equal thickness, the layer of pure rubber being then rather thicker than is usually put on now.

The compound rubbers are in a great measure only mechanical mixtures of rubber and other materials, and although when vulcanised their power of resisting atmospheric influences may be greater than that of pure rubber, their texture cannot be so close and uniform, and it is less easy to see by inspection what their qualities are than those of pure rubber. Still the exact proportions in which these different materials are used may in some measure be left to individual predilection, since with the thickness of covering advocated, a sufficient margin of safety is left if all the materials are of the best quality and well put on, to allow of considerable variation in details.

A certain *thickness* of dielectric was recommended, not less than $\frac{1}{8}$th inch, which at the same time was stated to be sufficient to stand 2,000 volts. A thinner insulating covering may be put on, but if cables are made with the intention that they should last without giving trouble and at the same time be able to stand a reasonable amount of wear and tear and chance accidents, such as being trodden on by a careless workman's iron heel, then for mechanical reasons it is not advisable to use a less thickness of dielectric than $\frac{1}{8}$th inch, to be increased proportionately if the tension used is higher than 2,000 volts.

Nothing has been said so far about different sizes of conductors or about insulation resistance. To stand the disruptive tendency of the current and to reduce the chances of its passing across the surface when there is a flaw, we need a certain thickness of dielectric. Now the tendency of 2,000 volts to find its way out of a single No. 16-wire is as great as out of a 19/12 cable, to keep it in we need the same *thickness* of dielectric in both cases. We do not need a greater thickness in the case of the larger conductor than the smaller; for the same E.M.F., the same depth of covering is required in each case, except that on account of the greater weight of the conductor in the larger cable and the extra strain this puts on the dielectric, it is advisable to somewhat increase the thickness of the covering on heavy conductors. With an allowance on this account, the same thickness of dielectric should be put on all conductors intended to stand the same E.M.F. It is particularly important to keep this in mind, because the smaller conductors are in practice often necessarily subjected to a good deal more handling and rough usage than the larger ones, which can be kept out of the way and are not often disturbed.

Supposing that its specific resistance is uniform, the actual resistance in ohms between the two sides of a sheet of dielectric $\frac{1}{8}$th of an inch in thickness, for example, will of course depend on the area or size of the sheet, so that if we have two sheets one double the size of the other, the larger one will only offer half the actual resistance the smaller one does, although its insulation resistance per unit area or per square inch of surface is the same. If we suppose this dielectric cut into strips and conductors laid longitudinally along the centre of the strip, then if the strip be folded over so as to enclose the conductor completely only a narrow strip will be needed for a small conductor, while a broad one will be necessary for a large conductor. Consequently with a small and a large conductor covered with dielectric to the same thickness, the actual insulation resistance of the smaller conductor will be much higher than that of the larger one, although the insulation resistance per unit area of dielectric surface will be the same, and the power of the dielectric to resist the tendency of the current to leave the conductor will be equal in both cases.

It is useless and misleading to judge conductors solely by their insulation resistance as is sometimes done now, since conductors covered with the same dielectric and to the same thickness will vary in their insulation resistance according to the size of the conductor itself. If cables are made to have the same insulation resistance for different sizes, then probably the smaller sizes will have less insulating material on them than they ought, while the larger sizes will be needlessly thickly covered. Again, the actual insulation resistance of a cable depends largely on the temperature at which the test is taken and the time which has elapsed since the cable was manufactured. From 60° F. to 75° F. the insulation resistance diminishes roughly to $\frac{1}{3}$rd, that is, the insulation resistance of a rubber-covered cable will be about three times as great at 60° F. as it is at 75° F. Also sometime after a cable has been made the dielectric seems to settle down, and its insulation resistance keeps gradually increasing.

As the bare fact that pipes would stand a pressure of so much per square inch, would not be held of much importance by a civil engineer unless he knew also what the diameter of the pipe was, what was the thickness and quality of the iron it was made of, and whether it was clean and free from flaws, so to the electrical engineer a knowledge of the insulation resistance of a cable alone is of little more value unless he has also the diameter of the conductor, the thickness of the insulation, and can see that mechanically it is well and evenly put on. Then the insulation test becomes of great value because it and the progressive electrification of the dielectric together form an exceedingly sensitive and accurate indication of the soundness or otherwise of the dielectric. Still, even then, an insulation resistance test is not a practical test of the dielectric, in the same sense that submitting a water-pipe to hydraulic pressure is, unless a high E.M.F. is used. To perform an analogous test, a current of about twice the E.M.F. the cable is intended to stand should be put on, and an insulation test made either with this current or after it has been on the cable for, say 10 minutes. This is really the crucial test to apply to a cable, and makers should now provide facilities by means of transformers or otherwise for carrying out such tests in the case of cables which are to be used for high tensions. If an insulated conductor will stand such a test as this and is satisfactory in other respects, there need not be much fear of its breaking down with proper usage under ordinary conditions.

Within the last few years greater attention has been paid to the protection of the dielectric covering of cables than was previously the custom, but it is doubtful if even yet we have got as far in this direction as it is advisable to go. It is easier than is generally supposed to make a cable that will stand a high tension when new, but the difficulty is to protect it from injury, and to keep it in perfectly good order for a length of time. In utilising insulated conductors for high tension currents, this is at least half the battle.

The qualities needed in such outer coverings are that they should be strong, flexible, waterproof, and not liable to decay themselves.

Tapes are more waterproof than braiding, but tape as an outside covering is apt to get torn, and then it is liable to unravel itself, especially if used overhead. The best way, therefore, is to use both classes of covering. First of all, on the top of the dielectric, should come a couple of coverings of stout twill tape, rather tightly put on, and wrapped in opposite directions. If these coverings are tightly put on, they will compress the dielectric somewhat, and so tend to keep close any fissures which might occur, and prevent in some measure water getting in. These tapes should be thoroughly saturated with a melted compound of ozokorite and wax before they are put on, and if then they are wrapped on with a good lap, they will form a very strong and impervious covering. A stout and close braid should then be put over all, and the braid also well saturated with compound.

If the braid is of good material it will last for some years, though it gradually loses its tensile strength as the compound gets washed away by rain or acted on by the atmosphere in exposed situations. There is, moreover, another action which must be carefully guarded against, as it is insidious in its nature, and the consequences may be serious. If a cable is wet from being tested in water with the outer protection coverings on, and is in this condition coiled on a drum, in warm weather a sort of fermentation may take place, accompanied by the presence of a slight mould, which in a very short time greatly deteriorates the strength of the fibrous material employed.

For underground work there can be no doubt that a metallic sheathing is the most reliable and durable outer protection. A sound cable drawn into a lead tube when quite dry is kept entirely free from contact either with moisture or the atmosphere, and should last without deterioration as long as the lead pipe does. Since in the case of a cable drawn into lead tube the coverings outside the dielectric are kept dry, they in addition to the dielectric offer a very considerable insulation resistance, which is a further protection against the formation of arcs.

Unless cables laid in conduits underground are mounted on insulators as Mr. Crompton proposes to do, the conduits, whether iron pipes, troughs, or perforated bitumen blocks should, whenever possible, be laid evenly and on a slight slope, so that water may drain off, and outlets should be provided at the lowest points for this purpose. But this precaution is of course less necessary if the cables are protected by a metallic sheath. Unfortunately with alternating currents, which in the future will probably be used for the larger proportion of high tension work, it is not admissible to use a metallic sheath to cover each conductor separately, because if the sheaths are in contact with the ground or any other conductor or semi-conductors, a return circuit is formed, and induced currents will be set up in the metallic sheath which might result, under certain conditions, in a serious loss. With alternating currents, therefore, unless the conductors are made up in the form of a concentric cable as has been done at Milan with good results, and with the exception of short lengths, metallic coverings for separate conductors are hardly admissible, so that we shall probably have to rely on tapes and braids as an outer protection.

In making concentric cables by the usual plan unfortunately the spiral wrapping of a set of conductors round the outside of the insulator of the inner set puts a heavy strain on the dielectric covering, and is not to be recommended unless great care is used in manufacture. If the outer conductors are simply laid longitudinally, it is on the other hand difficult to make a neat job, though by making proper machinery for the work no doubt this could be neatly and efficiently done. Where long straight lengths of cable are required without joints, probably there is no better, simpler, or more efficient plan of doing the work than by the use of concentric cables; but where frequent joints are likely to be required, as with mains running along streets for the supply of houses on either side, then concentric cables offer several practical difficulties which it is not easy to get over. The outer conductor must be cut through to get at the inner one, and it is difficult to make an efficient joint in the dielectric which will not be larger round than the original covering. If this is not done, then the outer conductors will not meet, and in any case it is difficult to solder them together again properly without damaging the dielectric underneath.

The United Telephone Company.—The snowstorm of December, 1886, has had a long-continuing effect upon the finances of the United Telephone Company. We thought twelve months ago that we had heard the last of it, when £15,777 was stated to have been the cost of it. In the accounts for the year ending April 30th, 1888, however, figures the following item :—"To snowstorm losses and allowances, £15,653 8s. 7d.!"

THE LIGHTING OF THE PARIS OPERA HOUSE.

In the issue of *La Lumierè Electrique* of June 25th we notice a second instalment of a series of articles on the electric lighting of Paris theatres. In the present number the Opera installation is described. It is stated that in 1886, after a three years' trial of 1,800 Edison lamps, it was determined to replace the whole of the gas lighting by electricity; from the article in question we gather the following particulars :—

	Number of original gas burners.	No. of incandescence lamps.	
		10 C.P.	16 C.P.
Management and service ...	1,269	1,165	40
Stage	1,897	1,568	320
Auditorium	2,254	1,212	306
Grand staircase, halls and promenades	1,967	1,010	642
Cellars	68	68	...
Totals	7,455	5,023	1,308

The boilers, engines and dynamos are placed in the cellars, and consist of :—

5 Belleville boilers.
1 Weyher and Richemond boiler for day service.
1 Corliss steam engine, of 250 H.P., running at 60 revolutions.
1 Armington-Sims steam engine, of 100 H.P., running at 300 revolutions.
4 Weyher and Richemond steam engines, of 140 H.P. each, running at 160 revolutions each.
2 Weyher and Richemond steam engines, of 20 H.P. each, for the condensers.
1 portable Weyher and Richemond steam engine, of 40 H.P., running at 85 revolutions, for day service.
12 Edison dynamos, 5 of 375 ampères, 4 of 800 ampères; 3 of 300 ampères; each of the 12 of 120 volts.
1 Gramme alternating current dynamo, for 24 Jablochkoff lights.
1 Edison dynamo, of 40 ampères, for the transmission of power to a centrifugal pump.
Accumulators: 120 cells of 132 lbs. for service of watchmen.
,, 60 ,, 132 lbs. ,, ,, safety lamps.

Plans are given of the basement or cellars, showing the arrangement of engines and dynamos, and the distribution of the circuits (26 in number), and a table is appended with details of the position, length, and sectional area of each circuit, and of the number of lights on, and ampères carried by, it.

Each Weyher and Richemond motor, together with a 1,000 lamp dynamo, forms an absolutely independent group, and the grouping as at present arranged offers four units of 1,000 lamps each, which can be worked together or separately, as the case demands.

CITY AND GUILDS OF LONDON INSTITUTE.

At the Central Institution of this Institute, during the last two weeks of July, a course of lectures and laboratory instruction on "The Construction, Testing and Use of Electrical Measuring Instruments," is to be given by Prof. W. E. Ayrton, F.R.S. This course will include experimental lectures and special laboratory work. The lectures will comprise the principles and practice of the construction, calibration, and testing for faults of ammeters, voltmeters, ohmmeters, wattmeters, coulombmeters, and ergmeters as used for direct and alternating current systems. The students' practical work will be conducted in a laboratory specially fitted with accumulators, standard instruments, &c., for electrical instrument testing, and they will have the opportunity of examining and practically trying all the more important electrical meters at present in ordinary use. This course will extend over two weeks, and will consist of six lectures, from 8 to 9 p.m., on Mondays, Wednesdays, and Fridays in the fortnight commencing on Monday, July 16th; and also of practical work in the physical laboratories, daily, Saturdays excepted, from 2 to 5 p.m., commencing on Tuesday, July 17th. The course will be very practical in its character, and will embrace the results of the experience that has been gained for some years past in the manufacture and testing of electrical measuring instruments, an experience in which Prof. Ayrton stands pre-eminent.

Electric Lighting in Australia.—It has been decided to call for tenders, in Sydney and Melbourne, for lighting the town of Young by electricity.

NEW ALTERNATING DYNAMOS.

By RANKIN KENNEDY.

(*Continued from page* 646.)

THE improvement of the alternating dynamo by increasing the power of the magnetic field and reducing the Foucault currents by lamination of cores is certainly the aim of most makers of dynamos of that class.

A powerful, and at same time economically formed, set of magnetic fields for an alternating dynamo can be formed only by using iron cores of ample section in the field magnet. Wrought iron is also preferable; the shape of the magnet should be designed to offer the least resistance to magnetism. Taking these requirements into account, the field magnets must in every case be massive as compared with the armature; but a massive and powerful set of magnets are not effective to their full extent unless the armature is so constructed that it also offers a very small resistance in its magnetic circuit. With this in view it is obvious that the armature must have an iron core, and that the air space between the poles of the field magnet and the armature cores should be very small.

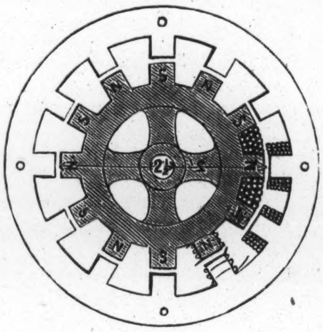

FIG. 1.

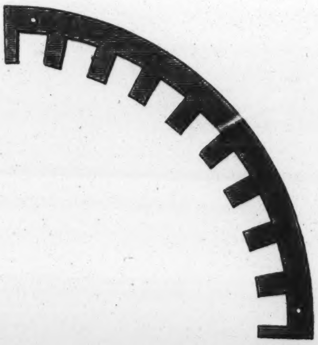

FIG. 2.

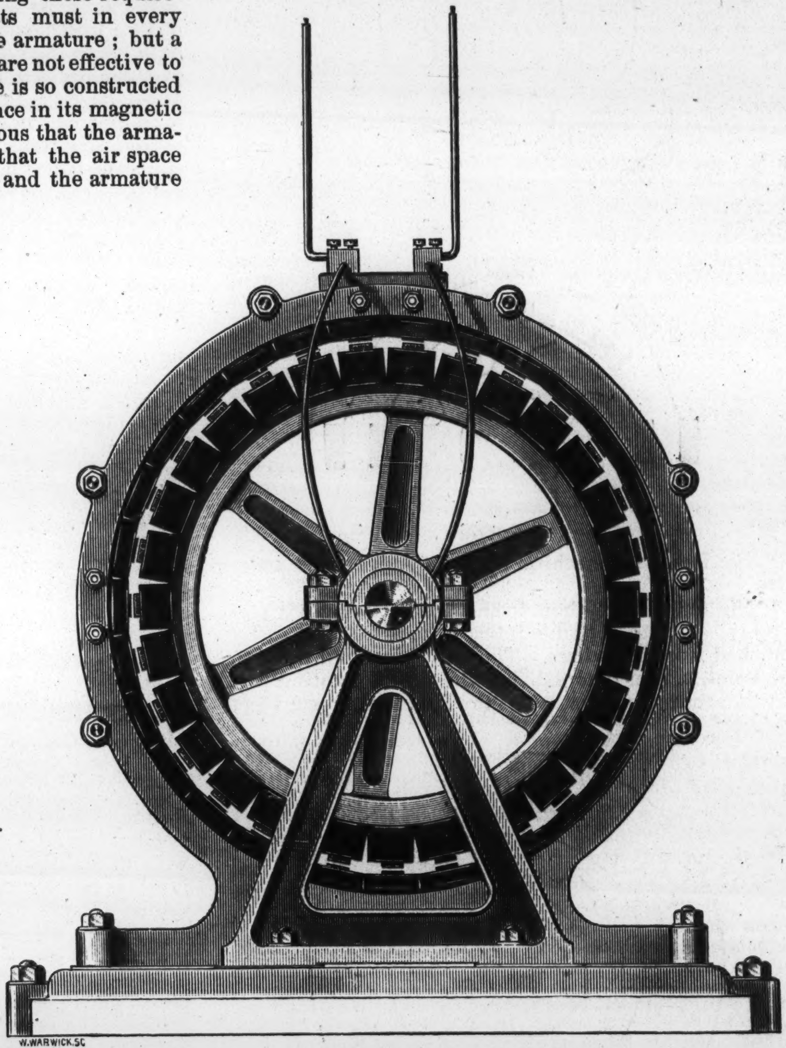

FIG. 3.

In the dynamos of Muirhead and Hopkinson, previously referred to, these points have been observed closely, and the design would form a very good model upon which to build an alternating dynamo of an improved type. The Westinghouse and the Zipernowski dynamos have both got iron cores in their armatures, but these iron cores are not brought up close to the poles of the field magnets, and therefore the effect of the powerful field magnets must be somewhat less than it would be if the iron of the armature projected close up to the poles.

A new dynamo is just now being manufactured by the Messrs. R. E. Crompton & Co., according to their patent specification, No. 17,120, 1886, Crompton and Swinburne, and which was described at some length in the REVIEW for February 3rd last. Of this machine we shall probably hear a good deal more than can be gathered from the specification. The improvement is wholly in the direction of obtaining powerful magnetic inductions by providing ample iron and reducing air spaces to a minimum.

The dynamo now being made is built on the lines of the specification, from which the following extracts are made, and from which the figures are taken:—

"For alternating current machines our invention is specially applicable. Fig. 5 shows an eight-pole machine. There are eight holes in the armature. These are shaped substantially as shown, so that when the armature is rotated there is the same induction through the field magnets, whatever the position of the armature holes.

"This overcomes one of the chief difficulties in alternating current machines, as it admits of iron in the armature without heating of the field magnets. Instead of A — A being the armature—that is to say, the part wound with wire, in which the alternating current is generated—the parts shown as field magnets may be used. The field magnets are then rotated inside the armature. The parts, C, C, should then be laminated. The field magnets, or rotating part, may be of a solid piece of wrought, or even cast iron. Fig. 6 shows another disposition of the stationary part. It is not so efficient electrically, but has certain mechanical advantages. The stationary parts in figs. 5 and 6 may be built up of punched pieces of sheet iron when they form the armature. Even when they form the field magnets it may perhaps be advisable to laminate them in large machines as the cross induction varies.

"The wire may be wound through the holes and back through the large central hole, but we prefer to wind it backwards and forwards through the holes, A, A, so that each neck of iron between neighbouring holes is surrounded by a coil of wire whose section occupies half the area of one hole. Instead of this arrangement the whole of the wire may be wound round alternate necks, so that with an eight-pole machine, as shown in fig. 5, there are four coils of wire on the moving part.

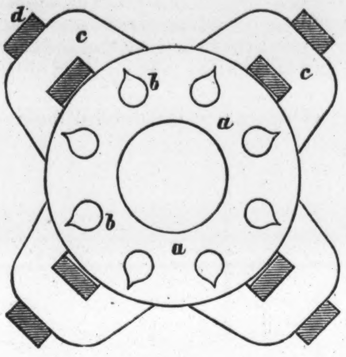

FIG. 5.

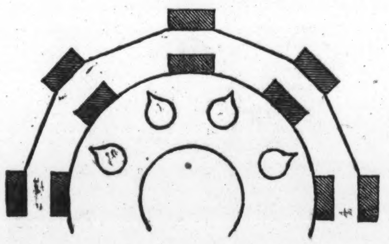

FIG. 6.

"Fig. 7 shows a machine with the holes in the outer part.

"The outer part then forms the field magnets preferably, as the rotating internal part can be easily punched from thin discs. The wire is wound through the holes, B, B, as before. The wire on the rotating part is wound as in an armature of the Pacinotti type, except that it gives alternating currents, as there are as many field magnet poles as armature coils. The stationary part may be made of cast iron."

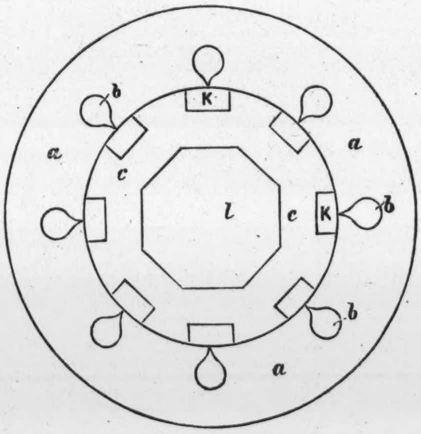

FIG. 7.

The following are the claims:—

"An armature with the conductor wound through holes substantially as described.

"An armature with the conductor wound through holes as proportioned that the induction in the field magnets is constant, or almost constant, substantially as described.

"The combination of a stationary part, with its conductor wound through holes and a rotating part, either being the armature, substantially as described."

Judging from the specification alone it would seem that this machine will certainly be a great advance in the construction of alternating dynamos; by using Swedish iron magnets of large dimensions, and a laminated armature running at a moderate speed, a very short armature wire coil should give a high E.M.F.

The author, in his pamphlet on "Electrical Distribution," page 10, illustrates an alternating dynamo in which the iron cores of the field and armature approach closely to each other.

In the foregoing fig. 1 the armature and the field magnet are shown diagrammatically. In the actual machine the armature is the inner wheel, and is much smaller than shown in the sketch. The outer ring, with inward projections, is the field magnets. The armature is built of thin iron stampings, and so is the field magnet ring, both being thoroughly laminated; the coils are slipped over the projections and fixed by screws. In this form of the machine the armature is rotated at a high speed, it being small in diameter and not heavy.

Iron stampings to form the large outer laminated ring cannot be made in one piece, of such large sizes as are required. The ring is built up of stampings made of the form shown in fig. 2, it being built in four segments and bolted together.

Fig. 3 shows a design for a large dynamo of the same construction, to meet the requirements of those who believe in slow speed—say, about 300 revolutions per minute. Such a speed is not in reality slow, as may be seen if we calculate the speed at the periphery of the revolving magnets.

In this machine the field magnets revolve inside of the armature, and are made of malleable cast iron. The armature has inward projections carrying the armature coils, and is built of iron stampings, same as figure.

To prevent heating of the field magnet poles it is found necessary to laminate them in this machine. The alternate approach and recession of the poles to and from the armature projections causes Foucault currents to be formed in solid projections.

(*To be continued.*)

ELECTRICAL TRADES AND THE LONDON CHAMBER OF COMMERCE.

OUR opinion has been asked on the desirability of forming an Electrical and Allied Trades Section of the London Chamber of Commerce. Amongst the matters with which it is suggested that the section might deal may be mentioned "Bills before Parliament, foreign tariffs, treaties of commerce, customs classification, arbitrations (for which the by-laws of the Chamber provide), business extensions in India and the Colonies, electric lighting legislation, fire insurance rules, telephone and telegraphic matters, &c. On these and other subjects, the recommendations which the section could make to the council would be of special value, and the influence of the Chamber with the Government departments, with Parliament, with provincial and Colonial Chambers of Commerce, and public bodies generally, would greatly assist in carrying them out. It is also thought that professional, as distinct from commercial, men, would be brought—through the section—into closer contact with the commercial community in regard to all matters where they have mutual interests."

There is no doubt that the matter is well worthy of consideration, and in another issue we may discuss the subject fully. In the meantime we place before our readers a letter received from a friend on the subject, and shall be glad to have the opinions of others interested.

"In common with others connected with the electrical trade I have been consulted on the question of the establishment of a section in the London Chamber of Commerce for the electrical and allied trades. As this is a matter that interests greatly the electrical industry in its many branches, amongst others, submarine telegraphy, land telegraphy, telephony, electric illumination, and electric locomotion, both from a manufacturing and working point of view, I think you should draw attention to the subject, in order to elicit opinions which may guide the promoters of the scheme to a sound solution of the problem laid before them. The proposal appears to offer many advantages to the electrical trades. In the case of manufacturers the London Chamber of Commerce, duly petitioned by the section in formation, may use its influence to benefit trading abroad in electrical goods through influencing the Home Government to take such steps with foreign Governments as may enable manufacturers to trade in foreign markets on terms at least as favourable as those granted to competing countries. Again, there is little doubt that the London trade will be benefited by attaching itself to a strong body which can make its voice felt in the country, where internal interests are concerned. For instance, the electric lighting branch of the trade would have greatly profited in the discussion of the Electric Lighting Bill in Parliament had this branch been seconded by the influence of the London Chamber of Commerce instead of depending only on the exertions of individuals. The advantages of a strong backing in all business transactions appear to me so patent to everyone, that I need not occupy your space in detailing them. If the other Chambers of Commerce of Great Britain would in their cities follow London's lead, the electrical trade of the country would be placed in such a position as to almost realise the results which have often been spoken of in your columns, and those of your contemporaries, as attainable by the formation of an electrical association.

"To make the proposal a success, the selection of the leading spirits is a point to be carefully considered. Trade jealousies, which are sure to be strong when so many are striving keenly for a living, should be avoided. It therefore appears to me that the choice of the chairman of the section and of the delegate to the general council of the Chamber of Commerce are most important points. Now that Charles William Siemens is dead, I think that you will agree that the most natural selection in electrical circles would be Mr. W. H. Preece, who has the general electrical matters and their wants more at his fingers' ends than any other person one could name. Unfortunately Mr. Preece is debarred from such a post by his official position and by the fact that he cannot well be asked to represent a trade. Sir John Pender and Lord Thurlow have been spoken of, but although exceedingly influential and able chairmen, their connection with electrical trade is only indirect. Amongst manufacturers the choice is next to impossible, as even if the trade could agree in a selection, however fair-minded he may be, this class of man will always be biased in his judgment. For this reason, and although Messrs. Siemens Brothers and the Silvertown Company may be said to represent the electrical trade in all its branches more fully than any other firms, I consider them and their representatives out of court. This argument also applies to other manufacturers who follow only one branch of the industry, and the additional disadvantage exists that at best they would represent but a portion of the interests involved under this head. Men like Messrs. Latimer Clark, Hopkinson, Ayrton and Perry, Crompton, and others, whose interest in the general trade is, comparatively speaking, small, should be also excluded.

"To find the men of sufficient influence, and possessing a sufficient knowledge of the general business, and with small personal bias, it appears to me that we should look to the technical press and to such consulting engineers as possess a knowledge of the whole electrical trade, and whose individual interests are not likely to clash with the general welfare. Should my suggestion meet with favour, the issue is very much narrowed, and the selection should not present any serious difficulty."

Removal.—Messrs. Mappin Brothers inform us that they have removed their silver, electro-plate, and cutlery business from 67 and 68, King William Street, to 35, St. Paul's Churchyard.

AMERICAN NOTES.

By DAS TELEPHON.

I SEND by this mail "Rules of Practice in the United States Patent Office," revised April 18th, 1888, and I invite the special attention of all those whom it may concern, to the *new rules* therein. I have heretofore called attention to the continual changes of these rules by the successive Commissioners of Patents, who seem to vie with each other as to who shall place the greatest number of obstacles in the path of applicants for patents.

It has been generally believed that the decisions of the Supreme Court of the United States were obligatory upon all persons; but it is evident that the Commissioners of Patents, and the Examiners, think themselves to be above those decisions. In fact, the proceedings in the Patent Office are but "snares and delusions," begotten by ignorance and sustained by arrogance.

The laws regulating the Patent Office enacted by Congress, are all that an inventor could wish; but the rules made from time to time by the officials of the Patent Office are quicksands in the way of the applicant.

It is to be hoped that the evils will be remedied some day by Congress, and rules established not to be changed by the Patent Office officials, so that an applicant for a patent may know well all that he is required to do to obtain a patent.

I intended to write somewhat anent the latest Yankee project, but a due regard for my reputation as a truth-speaking person forbids me; but that your benighted islanders may form some idea of the daring invention of the dwellers in this boundless Continent, I send you some extracts from the prospectus of the Electric-Automatic Transit Company of Baltimore City, which proposes to construct an electric railway for the transportation of mails and merchandise at a speed of ten miles a minute.

Among the directors will be found the names of some of the solid men of Baltimore, such as Alexander Brown, the well-known head of the old banking house of Brown and Sons, Mr. Abelt, owner of the *Sun* newspaper of Baltimore, and many others, prominent as bankers, merchants, and lawyers.

It seems to me that Shakespeare's saying—"Men have lost their reason," is, alas, too true. I send you the pamphlet from which I make the extracts.

"If there be one thing to be desired by the general public, more than others, and to accomplish which every available appliance should be used, it is a fast and reliable mail service. At present, mail trains are passenger trains as well, and the greater number of passengers carried on each train, the greater number of cars is necessary to transport them, thereby largely increasing the weight of matter to be pulled in transit. This necessarily interferes with speed; for let a train travel at the fastest time yet made, it cannot beat the record, as there is a point beyond which safety to life and limb is endangered. To transgress this bound, it would follow as a result that the speed would overcome the weight of the engine, and the jumping of the track, and a general smash-up would ensue. In our system, neither life nor limb is jeopardised, as our trains run automatically. There can be no jumping of the track, as the cars are held to the track by the upper guide wheel, whose flanges enclose the conducting rail on either side, thus rendering such an event impossible. It thus stands to reason, that an enormous speed can be attained, by electric force, used simply in proportion to the weight of the train. Mail matter can thus be transported with a safety and celerity hitherto unknown, and it will doubtless be a question of time only, after the above facts are demonstrated, when the public at large will demand the building of roads, under this system, to supply the exactions of trade in this important particular.

"The mechanical contrivance of this system is very simple, consisting of a light structure, elevated some twenty feet from the ground, thereby offering no hindrance to the cultivation of fields over which it may pass. Cars, pointed at both ends, are run on two tracks, having also an upper or third rail, which acts in the two-fold capacity of a guide rail and the conductor of the electric current. Each car is provided with an upper or guide wheel at each end, whose flanges enclose the upper or guide rail on each side, thus rendering the jumping of the track a matter of impossibility. The motive power consists of a permanent generator of certain prescribed horse-power, located at each end of the line, from which the current passes to the conducting rail, where it is immediately taken up by the travelling motor, to which one or more cars may be attached. The whole train is automatic in its action. On approaching its destination it passes a certain defined point where the electric current is permanently cut off, thus leaving the train to its own momentum, which gradually decreases. Each car then encounters a trip-lever, located at a sufficient distance from the stopping place, which springs the brakes in succession, bringing the train to a standstill in a very few moments, and at a designated point.

"As illustrating the enormous speed which is possible to be attained by this system, a trip could be made between New York and Chicago in two hours' time. A train passing through Philadelphia, Pittsburg and Cleveland, would take up the electric current from the permanent generating plants located in the respective places named, thus making the route continuous. These are simply matters of experimental detail, and are noted to give an idea of future possibilities. The distance from New York to Chicago is 911 miles, which at 10 miles per minute, a comparatively low rate of electric speed, would bring a trip within the time specified, making allowances for startings and stoppages. A road from thence continued farther south would bring the orange groves so near New York, that their fruit could be eaten with all its lusciousness and flavour of early ripening. Continuing farther on, San Francisco might be reached by through trains, making due allowance for stoppages, within nine hours. This suggestion is appalling, and doubtless will have many cavillers; but let them or anyone positively assert what may not, or cannot be done, under the marvellous and astounding daily developments of the use of the electric force, and we will take a back seat, and let him or them do the figuring for the future."

NOTES.

Street Lighting in Berlin.—The lighting of Unter den Linden with arc lights appears to be progressing, the underground cables having been laid, and connected with a central station in the Friedrichstrasse. It is proposed to instal 126 arc lights, the motive power being obtained at the station from four high-speed horizontal engines of the Armington and Sims type, and Siemens dynamos.

Electric Light in Brussels.—We learn that the Société Industrielle d'Electricité has obtained the contract for the lighting of the Northern Railway station for the sum of £2,400. The installation comprises a Walschaerts engine of 100 H.P., running at 66 revolutions per minute; one Lähmeyer dynamo of 105 ampères at 115 volts; and another of the same type giving 130 ampères at 115 volts. The Exhibition is, as to general details, being completed very slowly, but the engines for driving the electrical machinery are all in position and at work. It is said that the lighting of the gardens, where about 190 arc lights are employed, has turned out a complete success.

Electric Lighting in New York Harbour.—The contract for the plant and materials required for lighting Gedney's Channel, New York Harbour, with incandescent lamps on buoys has now been given out. There will be required 32,000 feet of three-wire conductors to connect the first two buoys, and 15,000 feet to connect the other four buoys with the three-wire circuit. The Edison Company has been awarded the contract for the dynamos, lamps, &c. The cost of the plant will be £5,200, and the estimated cost of maintenance £600 per year.

Tasmania and the Electric Light.—The Tasmanian Houses of Parliament are to be lighted by electricity.

The Electric Lighting of the Leeds Fine Art Gallery.—The Electric Lighting Committee of the Leeds Corporation visited the establishment of Messrs. Greenwood and Batley, in Armley Road, on Monday afternoon, and inspected certain dynamo machinery which may possibly be purchased in connection with the illumination by electricity of the Fine Art Gallery which the Corporation is building. The members of the committee are to consider a proposal to acquire the apparatus, and were to meet again to discuss the matter on Thursday.

Kensington and the Electric Light.—The electric light is extending in Kensington. The *Kensington News* states that Messrs. John Barker & Co. have decided to have the whole of their establishment fitted with the new system of illumination. The well-known hair-dressing establishment of Mr. Gaubert has been already fitted with the necessary cables, wires, and incandescent lights. The shop and the hair-dressing saloon have each six lights, and the ladies' saloon above eight lights, each of 32 candle-power. The effectiveness of the light, its comfort, coolness, and cleanliness, is thoroughly appreciated by those tradesmen and residents who have tried it.

The Electric Light in Leamington.—It is stated on good authority that the electric lighting company is about to introduce the light into the Midland Counties Hospital for Chronic Diseases, and also into the Sanitorium for Infectious Diseases. A scheme is on foot for illuminating the centre of the town by means of four or six arc lamps, to be placed in the tower of the Town Hall, over the clock dial. Each lamp is to be of 3,000 candle-power (nominal), and it is expected that the illumination will prove a good advertisement to the town as it will be clearly visible from the railways. Contingent upon the success of this scheme is the proposal to place several Pilsen lamps in the public streets. These are to be placed upon high poles, and the points at present indicated are near the railway bridges in Bath Street, the corner of Bath Street, near the General Post Offices, and at the top of the Parade. Another account of the contemplated changes is to the effect that experiments with the arc light will be made by Messrs. Chamberlain and Hookham, for the reason that the lighting of the Parade with incandescent lamps does not produce the satisfactory results which were expected. Before any extensive changes are made the Corporation will probably be approached in the hope that the town will bear a portion of the expense.

Electric Lighting in Birmingham.—Messrs. Chamberlain and Hookham have entered into an agreement with the Bingley Hall Company to provide electric lighting plant for the illumination of that building for the next three years. By an arrangement with the Cattle Show Council they will be prepared to arrange terms for illuminating the hall for any tenants who may desire to avail themselves of the advantage.

Telephonic Communication.—On Thursday the 21st inst. an influential deputation waited upon Mr. Raikes, the Postmaster-General, to ask him to support the reference of the United Telephone Bill to a Select Committee. The object of that Bill is to afford additional telephonic communication throughout the kingdom. The deputation was introduced by Sir John Lubbock, M.P., and included Mr. Matthew Quilter, M.P., Mr. Robertson, M.P., Mr. Jacob Bright, M.P., Mr. T. E. Dickson, M.P., Mr. Murphy, M.P., Mr. Whitley, M.P., Mr. Bonsor, M.P., Colonel Anstruther, M.P., Mr. Raymond Heath, M.P., Mr. Richardson, M.P., the chairman of the Telephone Company (Mr. James Brand), the deputy-chairman (Mr. J. S. Forbes), and the general manager (Mr. J. Morgan). Mr. J. S. Forbes stated the case for the company, and dwelt upon the facilities which had been given to the Hydraulic Power Company, the Gas and Water Companies, and other semi-public institutions in England, with the restraint and hindrance which had been put in the way of the telephone companies, who were often subjected to very great and unreasonable complaints on the part of the public for imperfect communication, when in reality it was chiefly owing to the want of proper facilities. Mr. Dickson, M.P., as a member of the Committee of 1887, spoke of the strong feeling which had found expression in the report of the Committee that an industry of this kind should be fostered and encouraged instead of being hindered by the Post Office, who by some accident had acquired a legal right to control the telephone. Mr. Houldsworth, M.P., spoke of the great importance of the development of this system to Lancashire. Mr. Jacob Bright, M.P., who followed, asked for some distinct statement as to what the Government were proposing to do on the question. The Postmaster-General, in reply, said the Government could not promise to support the reference of the question to a Select Committee. Next year the local government questions would be in a more forward state, and the matter was one with which county councils might deal. The telephonic patents would expire shortly, and then the Government might be able to deal with the development of the telephonic system. Afterwards a consultation was held, and the deputation decided to drop the Bill for this session.

Telephone Pole Rentals.—At the last meeting of the Whittington Local Board application was made by the National Telephone Company, Limited, for leave to erect poles through the parish (about 2½ miles). Leave was granted, subject to the payment of 5s. per mile.

Telephone Extension at Melrose.—The National Telephone Company has recently been making arrangements for connecting Melrose and Galashiels by telephone. The wire is run eastwards from Galashiels, through the lands of Abbotsford. The exchange in the Market Place, Melrose, was opened on Saturday.

The "Sherrard Osborn."—The Eastern Extension Cable Company's steamship *Sherrard Osborn* has called at Sydney, and after coaling, proceeded to New Zealand to repair the Cook's Straits cable. She has been engaged in laying and repairing cable in the China and Java seas, and in sounding in the Bay of Bengal, where a depth of from two to three miles was found.

The Electric Resistance of Copper at Low Temperatures.—A further contribution to this subject has just been made by M. Wroblewski, who undertook to test the truth of Clausius's remark in 1856 that the electric resistance of chemically pure metals should be proportional to their absolute temperature. M. Wroblewski, took advantage of one of the new methods of producing intense cold, namely, that by means of boiling nitrogen at the temperature of its solidification. The results are embodied in the following table, where *t* is the temperature, *r* the resistance in Siemens units, and *a* the coefficient of variation of resistance between two consecutive temperatures :—

Bobbin I.			Bobbin II.		
t.	*r.*	*a.*	*t.*	*r.*	*a.*
deg. C.			deg C.		
−100	5·174	...	+ 23·75	19·251	...
− 21·4	3·934	0·004365	± 23·75	17·559	0·004057
± 21·4	3·614	0·004136	−103	9·848	0·004263
−103	2·073	0·00414	−146	6·749	0·004104
−146	1·360	0·004588	−193	2·731	0·004869
−193	0·580	0·004592	−201	1·651	0·007688
−200	0·414	0·006562			

These numbers seem to show that the resistance decreases much more quickly than the absolute temperature of the specimens, and approaches nil at a temperature not very far from that obtained by evaporating liquid nitrogen in a vacuum.

A Narrow Escape.—An accident occasioned by a cause perfectly unforeseen, but which fortunately has not led to disastrous results, has just taken place, says *La Nature*, at the powder mills of St. Médard, near Bordeaux. The works, which cover a large surface, are lighted at night by six lamps with a Piper regulator. These lamps, which are supplied by a dynamo yielding 50 to 60 ampères, are mounted in series, two by two. At one of these lamps there was intercalated a resistance of about 28 ohms, enclosed in a square wooden box, placed at the height of four yards from the ground, upon the post supporting one of the lamps. In two of the sides of the box there had been left holes of the form of a trefoil. It seems that a tom-tit, in quest of a secure and comfortable place for its nest, fastened straws and twigs to the German silver wires forming the resistance. At the moment of the passage of the current the wires were heated to such a degree that they ignited the dry materials of the nest. Thence the fire spread to the box, which fell blazing upon the damp soil, and was soon extinct. But what might have happened if the ground had been dry, and if the fire had spread among withered grass to the buildings containing explosive matters? One of those strange catastrophes which all manner of scientific men vainly strive to account for.

Explosions and Glow Lamps.—Lieutenant Hutchins, of the United States Navy, has been making a number of experiments as to the risk of explosions when incandescent lamp globes are broken in explosive mixtures. The first experiment was made with a mixture of hydrogen and oxygen, Swan lamps being used. When the glass was broken the mixture exploded, but the filament was unbroken. The second experiment was made with marsh gas and air, when the filament was broken. Another experiment was made with coal gas, and after the bulb was broken the gas burned for some time. An explosive mixture of coal gas and air was next experimented on, and exploded after the breaking of the bulb. As it is claimed that the breaking of the bulb of an Edison lamp will always break the filament by the first rush of air, the same danger would not attend the use of the Edison lamp as is shown to be the case with lamps of stronger filaments. But even if all were equally dangerous in explosive mixtures, the liability of broken lamps and dangerous mixtures occurring at the same time is very slight.

Underground Conduits.—The *Scientific American* publishes the following table of the various conduits occupying the streets, showing how small a space is left for the laying of underground electric light wires :—Gas for lighting purposes ; gas for heating purposes ; fresh water for house supply and extinction of fires ; sea water for street watering and extinction of fires ; water for drains and sewers ; hot water at pressure for distribution of force and heat ; hot water at pressure for distribution of force ; compressed air for distribution of force, and for ventilation ; distribution of force and ventilation by vacuum ; transport of letters by compressed air and by vacuum ; cold water under pressure for distribution of force ; time signals by compressed air ; wire cables (mechanical) for machines, tramways, &c. *La Lumière Electrique* remarks that although the Paris streets are not as yet so heavily encumbered, the question is already assuming quite a serious aspect. For instance, on the Boulevard Montmartre there are two water pipes, a compressed air pipe, two pneumatic tubes used by the post office, a pneumatic tube for regulating clocks, and two systems of telegraph conductors. These are all carried in the main sewer, and it is not to be wondered at that the Paris Municipal Council should hesitate about granting permission for more conductors to be laid in the sewers.

The D'Humy Cabinet Battery.—By this time our readers will probably have heard enough about Mr. D'Humy and his "Water" and "Cabinet" batteries ; but in the last issue of *La Lumière Electrique* there appears a paragraph which we venture to reproduce, since it coincides with our opinion of the above-mentioned batteries :—"Mr. D'Humy deserts public lighting in favour of private lighting ; indeed, a lighting in all respects most essentially private, since there is announced in England the formation of a company for the promoting of a new battery called 'Mr. D'Humy's Cabinet battery.' It will be the more readily understood what is referred to when we say that the disinfecting qualities of the battery mentioned are loudly praised."

Electric Light in Philadelphia.—It seems that the Penn Electric Light Company, of New Jersey, has managed to get into trouble over the underground system which it had received permission to lay down through the city streets. It was stated that the laying of the conduits in the form of cheap board boxes was merely a cloak by means of which the company held possession of the streets. We learn that owing to the crossing of electric lighting wires with telephone and telegraph conductors several fires have been occasioned. Experiments are being made as to the lowest possible dangerous current with the view of protecting the telephone and telegraph instruments. We should have thought that a more careful construction of the lines, and the employment of properly insulated wires, would be more likely to serve the required end.

The Barcelona Exhibition Magic Fountain.—*El Diluvio*, of Barcelona, speaking of the inauguration of the illuminated fountain at the Exhibition in that city, says that the effect produced was truly magical. There is a central and vertical opening in the fountain with six other outlets, all leading from the main, which, when in play, ejects the water to a height, and other jets of water are forced from the centre. The effect of the electric light upon the falling water is to make it appear like showers of silver, all the light being centred round the small openings of the fountain, while distant objects seem very dark and sombre. In addition to this, any number of combinations of colours are obtained, such as green, violet, lilac, red, yellow, gold, &c., so that the water appears of one colour when ascending and of another when descending, while at times the jets from the central openings seem to shoot out like rockets of other colours. The inauguration was concluded by throwing upon the jets combinations of all the colours of the rainbow, the effect of which was considered to be very fine by all assembled. The fountain was the work of the Anglo-American Brush Electric Light Corporation, which was represented at the inauguration by Mr. Raworth.

Secondary Batteries. — Mr. Harry F. Bowling writes :—"Having had some experience in the formation of batteries of the Planté type, my attention was attracted to one paragraph in Sir David Salomons's letter which appeared in your last issue. He says, 'Plain lead plates *by frequent reversals* to obtain storage in a practical degree, fall to pieces very soon.' If it is not trespassing too much on your space, I should like to give you the results at which we arrived after eighteen months' experimenting with the Elieson accumulator. We found it was possible to form a positive plate up to its maximum storage capacity without any reversal whatever. Indeed, considering that it is simply a question of producing oxide of lead, it seems to be a rational conclusion to arrive at, that constant reversal should not be of any advantage in forming a good + plate. Again a plate, when thus oxidised, if carefully reversed, will become a better negative than any negative formed by constant reversals. I may say, as good a negative as any at present in the market. Sir David advances no explanation of his statement that plain lead plates, when formed, fall to pieces faster than artificially pasted plates, and considering that both processes arrive at much the same result, only by different means, there is no theory to support his contention. Is it not very early in the day to condemn plates formed easily and naturally from metallic lead ?"

Electric Belts—An Explanation.—Mr. W. G. Johnson, of the Medico-Electric Belt, Truss and Battery Company, has called upon us in reference to a leaderette which appeared in the REVIEW for the 15th inst., to explain that the letter there mentioned as having been sent to a friend of ours was forwarded through inadvertence. We take all the more pleasure in publishing the above explanation as Mr. Johnson has shown us a specimen of his electric belts, which contain three small sets of real batteries of seven elements each, properly arranged for the application of the current. The galvanic elements appear to be an improved form of Pulvermacher battery, and the article is a genuine one.

Attracting Lightning !—The following interesting paragraph appeared in several papers one day this week :—"A man was proceeding along the St. Leonard's Road, Bromley, during the thunderstorm last night, when he was struck by lightning and rendered speechless. A medical man was called in, and the man wrote down on a piece of paper a statement that he was carrying a magnet in his purse, and this, the doctor says, no doubt attracted the lightning. The man, whose name did not transpire, recovered sufficiently to be able to return to his home at Bow." Was he christened "Walker ?"

Depolarising Fluids. — A Bicester correspondent writes :—"May I ask why the composition of the depolarising fluid in the Weymersch battery is not given in the descriptive article in the ELECTRICAL REVIEW of the 22nd inst ?" The inventor, doubtless for very good reasons, into which it was not our business to pry, does not desire publicity at present.

Lighthouses on Tory Island.—Sir E. Watkin asked the President of the Board of Trade what further steps, if any, had been taken in the protection of life and property to connect the improved lighthouses on Tory Island by electric cable with the mainland. Sir M. H. Beach : I have reason to believe that Lloyd's are now in communication with the Postmaster-General on this subject, and there is a Bill providing signal stations through Lloyd's now before Parliament.

History of the Incandescent Lamp.—We learn that Mr. Arthur Shippey is writing a book upon the above subject. Mr. Shippey has collected during the past few years information from all countries relating to the matter. Under these circumstances, therefore, we have no doubt that the compilation of these records will be a veritable *bonne bouche* in electrical literature, and a welcome addition to "English, as she is spoke !"

Electric Railways in America.—There are now 130 miles of electric railways in operation in the United States—an increase of 50 miles in less than six months.

Electro-Medical Quackery. — The following letter appeared in a recent number of the *Medical Press and Circular :* "Sir,—Our attention has been directed to a paragraph in your issue of the 6th instant, having reference to the assumption of the title 'Dr.' by a Mr. C. B. Harness. Although the Medical Defence Union is chiefly intended for the protection of the immediate interests of its members only, on an insurance-like principle, still the Council have determined in the particular case you have brought forward to take such steps against the offender as it shall be advised, and the initial step has already been taken. We are, Sir, your obedient servants, A. George Bateman, M.B., Leslie Phillips, M.D., Hon. Secs. Medical Defence Union, Medical Institute, Birmingham, registered office of the company." We have heard that since the appearance of the above, Mr. Harness has written an apologetic or explanatory letter to the Medical Defence Union, intimating that the occurrence of "Dr." in some of his advertisments was pure accident. We should like to know in how many advertisements and for what length of time Mr. Harness has been styled "Dr."

A Simple Test.—Referring to Wilke's polarisation paper which we mention in this week's issue, we may remark that a common practice amongst the telegraph linemen of the General Post Office is to moisten the finger with saliva and apply the two wires from the pole of the battery to the moistened spot, when it will be noticed that an effervescence at the negative pole, due to the evolution of hydrogen, takes place.

The Sawyer-Man System for England.—The intentions of the Consolidated Electric Company, owners of this system, of ultimately coming to England is said to be no longer a secret, as Col. Hy. C. Davis, the president of the Saywer-Man Electric Company, is in town, and has already interviewed several of our leading firms respecting the supply of the Sawyer-Man lamps for English consumption. The Consolidated Company, under the presidency of Mr. Westinghouse, appears to have made great strides in America during the past year, and the company has recently built a new lamp factory in New York with a capacity for turning out 10,000 lamps per day.

Marine Biology and the Electric Light.—The Liverpool Marine Biology Committee had a three days' dredging expedition in the *Hyæna* during Whitsuntide, and Prof. W. A. Herdman has contributed to *Nature* a brief account of the expedition. He says: "The important feature of this cruise, however, was the use which was made of the electric light for collecting after dark. On the first night, in Ramsay Bay, after the shore party had left and the ship was anchored for the night, an electric light of 1,000 candle-power was hoisted a few feet above deck, and this allowed work to be carried on almost as comfortably as during the day. Captain Young, of the Liverpool Salvage Association, who was in command of the *Hyæna*, then kindly arranged for me a 60 candle-power Edison-Swan submarine incandescent lamp in the mouth of a tow-net. This illuminated net was carefully let down to a depth of three fathoms, and allowed to remain there for half-an-hour. At the same time another tow-net, without any light, was let down to the same depth over the opposite side of the ship. When the nets were being hauled in, as the one with the electric light approached the surface numerous small animals (Crustacea probably) were noticed accompanying it, and darting about in the bright light. This tow-net, when emptied into a glass jar of sea-water, was found to contain an abundant gathering, consisting mainly of Crustaceans, while the net in the dark on the other side of the ship had practically nothing. The two nets were then put out again. The one had the electric light in its former position, but this time it was let down to the bottom at a depth of six fathoms, while the other net was placed in the dark at the ship's stern, and also reached the bottom. The tow-nets remained stationary, but were kept distended by the tide. The outline of the illuminated net could be made out indistinctly at a depth of six fathoms. After being out for three-quarters of an hour, both nets were hauled in, with the same result as before. The illuminated net contained abundance of Crustacea (chiefly Amphipoda, Schizopoda and Cumacea), while the dark net again contained practically nothing. These two experiments showed pretty conclusively the effect of the brilliant light in attracting the free-swimming animals, the difference between the contents of the two nets being on both occasions most marked. Consequently, on the second night, in Port Erin Bay, *both* nets were illuminated, and while the one was let down close to the bottom, at a depth of five fathoms, the other was kept at the surface of the sea on the opposite side of the ship. This experiment was tried three times, with the same result each time: both the nets were found to contain abundance of animals, but the bottom and surface gatherings differed greatly in appearance and in constitution."

International Cable Company.—Occasionally shareholders make considerable errors, says the *Financial News*, when they apply to the courts for relief, in the shape of having their names removed from the register of a company. Such a mistake was made by a Mr. Wright, a holder of 40 shares in the International Cable Company. He applied to Mr. Justice Chitty to have his name removed from the register on the ground that the prospectus issued by the company contained a misstatement to the effect that a contract had been entered into by the company with Henley & Co.'s Telegraph Works Company. At the hearing of the motion the International Cable Company produced in court the contract in question, and the application was dismissed with costs.

A New Electric Pump.—A new electric pump, the invention of A. E. Hall, of Plainfield, N.J., is designed for pumping water from any depth to any specified height in hotels, residences, stores or factories, wherever the motive power can be obtained from an incandescent electric lighting plant. It is expected to prove especially serviceable in the case of deep dug wells, where ordinarily the water has to be lifted at considerable expense, as it is composed of bronze metal not liable to rusting, and can be placed low down near the water, thus taking the place of the lifting apparatus. A pair of rotary pumps encased, is driven by means of a worm gear attached by a small shaft to an electric motor. This peculiarity of the gear is designed to prevent any slipping, as sometimes in the case of belts, and a solid stream of water is forced to any desired elevation without pulsation or other irregularity. The power is taken from the wires of either incandescent or arc electric lighting circuits; the mechanism is entirely automatic, and the only attention ever needed, after being set, is a weekly supply of oil.

Edison's Phonograph.—The Edison improved phonograph is now being manufactured at Bloomington, New Jersey, and this substitute for a shorthand clerk is to be sold for £17. A company to carry on the manufacture has been formed at Newark, N.J., with a capital of £60,000. Col. Gouraud has sent to the papers an interesting account of the receipt by him of the first of the "perfected phonographs" to reach this country.

NEW COMPANIES REGISTERED.

Automatic Illuminated Views Company, Limited.—Capital £50,000 in £1 shares. Objects: To purchase certain inventions and patent rights, the property of Messrs. W. S. Simpson and W. S. Oliver, particulars of which are not given in the registered documents; to manufacture and deal in automatic or mechanically contrived boxes, machines and apparatus for displaying stereoscopic views or photographs, and also kaleidoscopic, microscopic and other optical effects on glass or other transparency, and lighted by electricity, gas or otherwise. Signatories (with 1 share each): Herbert Marshall, Alfred Barrett, 15, George Street, Mansion House; J. S. Marsden, 89, Sebert Road, Forest Gate; A. C. H. Watkin, 2, Riches Court, Lime Street; W. Shepherd, 17, St. Paul's Road, Canonbury; J. C. Sykes, 57, Martha Street, E.; J. A. Kelman, 49, Lombard Street. Registered without articles of association on the 21st inst. by John B. Purchase, Mansion House Chambers.

Buckingham Electric Light and Power Supply Company, Limited.—Capital £5,000 in £1 shares. Objects: To carry on at Buckingham and elsewhere in the county of Buckingham, the business of an electric light and power supply company in all branches. Signatories (with 1 share each): A. C. Rogers, J. Wilson Thorpe, G. Watson French, A. Vyle, H. Thorpe, L. Varney, all of Buckingham; Wm. Habgood, electrical engineer, Hazlebrook, Buccleuch Road, West Dulwich, S.E. Directors' qualification—25 shares. Registered 22nd inst. by Henry Small, Buckingham.

Electrical Purification Association, Limited.—Capital, £15,000 in £1 shares. Objects: To acquire and work the following letters patent granted to William Webster, viz.:—No. 1,333, January 27th, 1887, "Improved means of oxidising and decomposing by electrical action organic matter and inorganic salts in sewage, water, and other liquids." No. 15,760, November 17th, 1887, "Improved apparatus for the electrolytic treatment of sewage and other impure liquids." No. 472, January 11th, 1888, "Improvements in apparatus for treating sewage and other impure liquids by electrolysis." No. 1,105, January 24th, 1888, "Improvements in the means or appliances for treating sewage by electrolytic action, and for disposing of the deposits thereof." Signatories: *Wm. Webster, 50, Lee Park, 2,000 shares; *Thos. Slater, 19, Great George Street, 1,000 shares; John Crow, 54, Wickham Road, Brockley, 1 share; J. Hunter Jones, C.E., Cairo, Egypt, 1 share; *A. Cassavetti, 6, Clarendon Place, Hyde Park, 1,000 shares; Wm. Porter, Baring Lodge, High Road, Lee, 1 share; *Edwin Webster, 9, Lee Terrace, 1,500 shares. The signatories denoted by an asterisk are the first directors. Registered 23rd inst. by Hargrove & Co., 3, Victoria Street, Westminster.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Notting Hill Electric Lighting Company, Limited.—The statutory return of this company made up to the 20th inst. was filed on the 22nd inst. The nominal capital is £100,000 in £10 shares. 91 shares have been taken up, and £2 per share has been called up. The calls paid amount to £152 and unpaid to £30. The operations of the company have been delayed owing to the vestry of Kensington not having yet signified its approval as required by the Electric Lighting Act 1882. The call mentioned above is not due until 29th inst., and the calls have therefore been paid in advance, Registered office, 20, Great Winchester Street.

Rogers Electric Light Syndicate, Limited.—A final meeting of the shareholders in this company was held on the 31st ult., when an account was submitted as to the manner in which the winding up has been conducted and the property of the company disposed of.

Anglo-American Brush Electric Light Corporation, Limited.—The annual return of this company, made up to the 16th March, was filed on the 22nd inst. The nominal capital is £400,000 in £5 shares. The shares taken up are 26,657, with £5 paid, and 24,357 with £4 paid. The calls paid amount to £230,234, and unpaid to £479.

Hills and Thomson, Limited.—An agreement of 21st April provides for the purchase by the company of the effects, late the property of the Northern Electrical Engineering Company, for £1,450, payable £1,000 in fully paid shares, £400 in debentures, and £50 cash.

Protean Battery Syndicate, Limited.—An agreement of 22nd February, filed 14th ult., provides for the purchase by the company from Wm. Kingsland, of 49, Cambridge Road, Gunnersbury, electrical engineer, of the letters patent No. 1,654, dated 2nd February, 1887, for an improved method of closing or sealing secondary battery cells; No. 5,867, dated 22nd April, 1887, for improvements in secondary batteries; also Belgian and French patents, and a registered design for an electric lamp, No. 91,514, dated 16th January, 1888. The consideration is a cash payment equivalent to 25 per cent. on all cash paid from time to time on the first or any subsequent issue of shares, and also an allotment of fully paid shares equal to the number allotted to subscribers. Mr. Kingsland is appointed managing director at a remuneration of £10 per month, with a further remuneration of £50 for every 1 per cent. per annum dividend in excess of 5 per cent.

Electrical Automatic Delivery Box Company, Limited.—The registered office of this company is now situate at 10, Moorgate Street.

LEGAL.

Taylor v. West African Telegraph Company.—(Before Mr. Justice Field and a Special Jury.)—In this action, Thomas Ducker Taylor sued the defendants for an alleged breach of contract. In October, 1885, he alleged he had entered into a written contract with the defendants, under which they agreed to employ him as an instrument clerk and superintendent of their branch works at Bathurst, on the Gambia coast. By the contract he was to receive £300 a year, and it was determinable by three months' notice or three months' salary. On December 27th, 1886, the defendants dismissed the plaintiff without such notice or payment in lieu thereof. This agreement not having been stamped, could not be put in evidence, the plaintiff not caring to pay the penalty—namely, £10. The learned judge made some strong comments upon the frequency of cases such as this where companies neglected to stamp their agreements. This habit, his lordship said, often caused a great deal of injustice; and as the stamp was so small there could be no excuse. His lordship permitted the plaintiff to amend his claim and plead that in such an engagement of service three months' notice was customary, and also admitted a letter from the defendants' manager to the plaintiff as evidence of the terms of the alleged written agreement. The defendants pleaded that they had dismissed the plaintiff for good cause. Their chief complaint against the plaintiff was that he was given to habits of intoxication. This the plaintiff denied, and asserted that if, as was said by some of the medical witnesses, he exhibited at times the appearance of intemperance, that these were due to the fact that he was a great sufferer from fever and other climatic influences. The evidence consisted chiefly of depositions taken on the Gambia coast from natives and others. At the close of the case the learned judge carefully summed up, and left it to the jury to say whether or not, upon the whole of the evidence, the defendants had satisfied them—for the onus was upon them to do so—that they had acted with reasonable and good cause in dismissing the plaintiff. If not, then the plaintiff was entitled to not only the arrears of salary claimed—namely, £11 5s., but also to three months' salary in lieu of notice. In dealing with the question of good cause the learned judge reminded the jury of the responsible—and in a sense confidential—position in which the plaintiff, as head of an important telegraph station in a foreign country, was placed towards his employers at home, and referred to the case of "Pearce *v.* Foster" ("L.R." 17, Q.B.D., 539), *per* Lord Esher, M.R., where it was held that if a servant has done anything incompatible with the due and faithful discharge of his duty to his master, or by his own act prevents himself from performing his duties, the master is justified in dismissing him. It was for them to say whether in this case the plaintiff had come within that ruling. The jury found for the plaintiff for the amount claimed. Judgment accordingly.

Swaby v. Watt and Others.—(Before Mr. Justice Stirling.)—In this action by Lewis Swaby against Hugh Watt and others, directors of the Maxim-Weston Electric Company, Limited, Mr. Pearson, Q.C., counsel for the plaintiff, moved for an injunction to restrain the defendants from forfeiting or cancelling 400 shares of the company held by the plaintiff or allowing any notice, minute, or other entry alleging such forfeiture or cancellation to remain on the register or the minute book of the board of directors. Mr. Graham Hastings, Q.C., counsel for the defendants, said he had received only on the previous night a long affidavit for the plaintiff. Mr. Pearson: It is simply an answer to yours. Mr. Hastings: Very likely, but still I would like to read it. Mr. Pearson: But it is absolutely necessary that the motion be taken at once. Mr. Hastings asked for delay, but said that in the meantime he would undertake that his friend's client should not be interfered with in acting as a director. Mr. Pearson said that on the last occasion there was an undertaking given to produce to the plaintiff certain minutes. He had applied for them again and again, and could not get them produced. Mr. Hastings: I am told a copy was made for you, so that there must have been some misunderstanding on that point. His lordship then granted postponement on an undertaking by the defendants over next motion day that the plaintiff should have and exercise all the rights of a director of the company.

CITY NOTES, REPORTS, MEETINGS, &c.

Pilsen-Joel and General Electric Light Company, Limited.

An extraordinary general meeting of this company, convened in compliance with a requisition of the shareholders, was held in the Cannon Street Hotel on Wednesday, the chairman of the company, Sir Rawson W. Rawson, K.C.M.G., C.B., presiding.

The notices convening the meeting and the requisition having been read, the minutes of the previous meeting were called for by a shareholder and were read.

The Chairman then said: I have now to inform you what means we have taken upon the resolution passed at that meeting with regard to the disposal of the business. Our original proposition, made in our notice for the first meeting on March 23rd, was that the directors, with the power which was vested in them, should make a call of 5s. per share for the purpose of meeting the existing liabilities, and of extending their installations from their two stations; and in order that the shareholders might divide the profits resulting from such extension, that the nominal value of the capital should be reduced to the minimum. It was evident at the adjourned meetings on April 13th that the shareholders were not disposed to advance further capital for the purpose of extending the business; that was made very clear to us. I had apprised the shareholders in my circular letter of March, I had stated here at the previous meeting, and the committee that examined into our affairs had stated very clearly that it was indispensable to obtain money to carry on the affair, and to meet the liabilities of the company even without any expansion. We were as desirous as any shareholder who attended the last meeting to carry out the views of that meeting, if it appeared likely that it would be confirmed at a second meeting which it would have been necessary for us to call, in order to proceed legally with any action upon the recommendation, direction, or instruction, or whatever you like to call it, of the last meeting. Myself and my colleagues, who were re-elected at the last meeting, were under the very firm conviction that the shareholders in general were not disposed to put an end to the company, that there were many of them who were more disposed to carry on and await better times for realising the value of their business and obtaining some return for the money which has been expended by them. Therefore, when the resolution was passed three alternatives presented themselves to the directors, one to adopt the view of the last meeting, which was to get rid of the business as fast as possible, another to adopt the view which we advocated, and which we believed a number of our shareholders were disposed to advocate, namely, to carry on and to extend our installations gradually, and the third to devise some middle course which would reconcile the views of the two divisions of our shareholders. At the board meeting within about a week of the meeting, we found ourselves in this position: that the proceedings at that meeting had become known to parties who had claims upon the company, and who were not only prepared, but actually did, without giving us a chance of meeting them, take legal proceedings against us. As you are aware, our balance at the bank was reduced to the smallest sum; our rentals from the installations would not come in for another month, and we were under an obligation to meet our liabilities. Therefore we had no option in the matter; we could not obtain the necessary funds without making a call. We were hurried into that necessity from no action of our own, and certainly from no indisposition to come to an arrangement, had it been possible, by which we might have avoided a call. Therefore we found ourselves under the necessity of reconsidering our position with regard to the future. Should we maintain our own view, and what we believed to be the view of an influential body of the shareholders, to continue the business, or should we adopt the view of those who carried the motion at the last meeting, to proceed to a sale of the business as speedily as possible? The directors determined to adopt the latter view and to act entirely according to the desire expressed by the meeting, the difference being that many who voted for that instruction did so in the expectation that there would be no necessity for making a call. There was a disposition expressed by some shareholders to advertise the business for sale. The directors did not consider, in the position of the company at that time, that that was an eligible course. They thought it would be injurious to the interests of the company, more particularly after the publication of the proceedings at the last meeting. We, therefore, acted upon instruction, which was to consider the best means of disposing of the business. We immediately proceeded to try to dispose of the business and to enter into communication with those parties who were likely to take the business off our hands, and to endeavour to effect an arrangement with them. That has been proceeded with, and it has delayed our calling you together to a certain extent, for the negotiations have been continued up to the latest date. But we believe that we have the opportunity of laying before you a proposal which will realise the value of our assets at the present time, will obtain as full a value for them as we are likely to get, will release our shareholders from any future obligations with regard to calls, and will so far meet the wishes of, we believe, the majority of the shareholders. One of my colleagues will lay this matter before you. I wish to say that I myself have not interfered in this matter at all, inasmuch as it was suggested that my judgment or feelings might be interested on account of my son's connection with the firm. My colleagues have dealt with it, and one of them will explain to you his proceedings. The other point that I have to bring before you is the question of the amount of the call. We originally proposed 5s., with the view of meeting our liabilities and of extending our installations. When it was obvious that our shareholders were not disposed to carry on the business, and desired it to be wound up as speedily as possible, and of course with as little expense to themselves as possible, we had to consider what amount would be required to attain three definite objects. One was to cover all liabilities existing or likely to accrue from the state of things as it existed at the moment; another was to provide for one quarter's maintenance of our installations, because we have to furnish our customers for a quarter at least before they pay, and we were bound to consider the interests of our customers, with which our own were closely bound up; and the third was to raise such an amount as would render it absolutely certain that we should not be required or that any parties taking the business from us should not have to make another call. It would have been a very unwise thing of us to make a 2s. or 2s. 6d. call if it was likely or possible that we should have to make another call for 6d. or 1s. Therefore, inasmuch as we should spend no more of this money than was absolutely necessary, we made a call of 3s. instead of 5s., which would make it certain that we should have sufficient to wind up the business. With regard to the negotiations, I will ask Mr. Whateley, who has been good enough to undertake them, to state what has been done; but I would like to mention what has struck me as being amongst the difficulties which this matter presents. One of our difficulties is that all our arrangements are annual. Our contracts with our customers are annual; the contract with the Government for the Bethnal Green Museum lighting is annual; the contracts with all the different parties are annual. That affects very much the value of our assets, because it is in the power of these parties to withdraw, and purchasers may make the objection that there is uncertainty attending our arrangements. Another objection, with regard to our plant, is that the latest types have so far improved upon it that it is practically out of date. Then with regard to the patents, that has been another difficulty, because most of the parties who are lighting in London and elsewhere have their own patents, and are not disposed to pay us for the patent for another lamp when they are satisfied with their own or others that are in the market. Before Mr. Whateley speaks to you, I will propose the resolution which the board has only within the last day or two felt itself in a position to offer you. It is: "That the instructions to the directors to sell the property, goodwill and assets of the company, given at the general meeting held on April 13th last, be and the same are hereby adopted, and that the directors be and are hereby authorised to accept payment in cash or fully paid shares of any other company, or partly in cash and partly in such shares as may be arranged, and that a committee of three gentlemen be appointed to consult with and assist the directors in negotiating for such sale." The three gentlemen whom we wish to associate with ourselves, as having the largest interest and being the best capable of assisting us in the matter, are Mr. Dillwyn Parrish, Mr. Phillips, and Mr. Hopkins. We are most anxious that the shareholders shall have the fullest security that we do not fall short or err in our arrangements for their benefit.

Mr. Frank Fellowes questioned the competency of the meeting to deal with the resolution. Had he attended the previous meeting, which was called for a specific purpose, the election of directors, he should have objected to such a discussion as then took place and such a resolution as was then passed as being *ultra vires*. The speaker proceeded to condemn the action of the directors in depreciating the value of the company's property in the balance sheet, and in paying dividends since 1884. He believed they had a good business, and thought that certain business men should be associated with the directors to try and get figures together in a friendly manner, and to see what were the prospects of increasing their installations.

Mr. D. Parrish said that at the last meeting the directors proposed the very course which Mr. Fellowes now advocated, but a number of shareholders said they wanted the business sold, and a resolution was passed instructing the directors to endeavour to sell the business. Mr. Fellowes had suggested the raising of money upon debentures, but he ventured to say that they would not raise one penny by means of debentures. As regards dividends, the shareholders had declared them, the directors only recommending them.

Mr. Whateley said when the board came to the decision they did, after a great deal of consultation as to whether they should sell by tender or not, they formed the opinion very deliberately that to offer the affair by tender or auction would be to sell the plant practically for next to nothing. He was told by gentlemen of considerable practical knowledge that their plant was not of the most modern type. The first people he approached were the Grosvenor Gallery people. They positively declined to have anything to do with the matter on the ground that the plant was out of date. He next went to the House to House Company and to the Anglo-American Brush Company, who said just the same, and he then had some communication with Messrs. Crompton, the upshot of which was that Mr. Crompton said he would bring the matter before the Kensington Court Company. He (Mr. Whateley) had written two or three times to the Kensington Court Company, but had never had any reply. He then went to Messrs. Woodhouse and Rawson, who took a great deal of trouble to see if they could meet them. He had several interviews with Mr. Foote, of their firm, who was actively engaged in forming a syndicate for electric lighting with a capital of £50,000. Messrs. Woodhouse and Rawson proposed to take one-fifth of that capital, one-fifth would be offered to this company, and there was a third company to which it was proposed to give another fifth; and Messrs. Woodhouse and Rawson said they could find people to put in the rest of the money. The important point was that they (the Pilsen Company) were to have one-fifth of that large sum. It was now in the hands of the shareholders to carry on the negotiations or to drop them. If the proposed sale were carried out they would propose to wind up themselves, and as the liabilities were very moderate, allowing for calls unpaid he thought they would be able to return something like 1s. per share.

Mr. James Fyfe said he signed the requisition for a sale under supervision as the lesser of two evils under the then existing circumstances. The directors had been instructed by a meeting—which restored them to power for that sole purpose—to sell the business, and he opposed both their restoration to power and the sale, as he considered neither was for the benefit of the shareholders. The directors had also expressly withdrawn at that meeting their announced intention of making the call they were proposing of 5s. The report of the committee of investigation was only not read at that meeting for the reason that the majority then present of the shareholders, as they were deciding upon a sale, considered it unnecessary to have a discussion upon the report, disclosing as it did the gross mismanagement of the directors, and to avoid this discussion a vote of thanks to the committee which had prepared the report was suggested by one of the directors themselves and unanimously carried; and he might mention that the expenses of that report had not yet been paid by the company. This was the position of matters after the last meeting. But the directors now said they were put back into power formally, but the sole condition and reason for this, that they should sell the business, was informally carried, and they would ignore it and continue their management. He (Mr. Fyfe) considered that any course, even a sale, which he strongly opposed, would be better than continuing the business under this management, which had in four years worked so much harm, had been doing a largely decreasing business year by year with an annual increase of expenditure, and in addition had in 18 months squandered about £4,000 invested moneys of the company. He accordingly joined with other shareholders in a requisition to the directors to call a meeting to make that formal which they said was informal, viz.:—the resolution for sale. The directors now said they had been privately negotiating for a sale of the business, which was what they were not asked to do, and they said it had been proposed to them by one shareholder that the directors, who had been acting for a year and-a-half improperly, should have a sum of money voted to them for their signal services to the company. The real practical question was as to the future of the company, and as to the policy to be pursued. If the business were to be sold, what was likely to be given for a business which had been allowed to run for four years practically without any profit, which had been so publicly discredited as this had been by its directors, who issued a circular stating that its goodwill and patents, lately valued by themselves at £25,000, were now worth only £500? Really all, on the directors' showing, that the company's assets consisted of was the stock, which they valued at £3,874; yet in their private negotiations, all they had been offering for sale were the patent rights, which they had valued together with the goodwill at £500 only. The call of 3s. per share which the directors had made, in breach of the understanding upon which they were re-elected, should realise £3,670. So that the result of a sale, as the directors put it, would be nothing for goodwill and patents, which were only worth £500 last year; the call of 3s. was said to have been necessary to meet liabilities, so that nothing would come back from that. The effect of this sale would be, that since the last meeting the directors had called up further capital of £3,600 to enable them to sell for about that amount. He thought it was not in the interests of the general body of shareholders of the company that there should be a sale at all. They had a property, the mere goodwill and patents of which were valued last year, and he thought moderately, at £25,000, which admittedly was earning, even under utterly inefficient management, over £5,000 per annum, from customers of undeniable responsibility, which had central lighting stations of almost unique advantages in the electric lighting business, and capable of practically unlimited extension for further customers, whom the present directors would not even supply when brought to them. The lamp was admittedly the best arc lamp in the market. The company had the patents for India, Australia and Canada in addition to the patents for the United Kingdom, none of which, except the English, had been worked or sought to be worked. The full working stock and plant were valued by the committee at £10,000 and upwards. And all these were to be put into the market and thrown away for what anyone would give for it. What he thought was the true solution of the difficulty was to invite the directors to resign their positions and select, at a future meeting, three business men from among the body of shareholders to conduct the business of the company. This company would then be as prosperous in the near, if not the immediate future, as it had been unprofitable and almost disastrous in the past. Firmly believing this, and that any sale would be a most mistaken policy, he moved the following amendment to the resolution:—"That in the opinion of this meeting any sale of the company's business at the present time is inexpedient; that the proposal to make a payment to the directors for acting as they did whilst disqualified be not entertained; that the present directors be requested to resign; and that the secretary is hereby directed forthwith to convene a meeting of shareholders to elect other directors."

Mr. Gibberd seconded this amendment.

Mr. Gwynne and Mr. Hopkins having spoken,

Mr. Garrod, the solicitor, said whatever might have been the case at the last meeting, there was no question that it was perfectly competent for the present meeting to carry any resolution with regard to the disposal of the business.

Mr. Phillips submitted a motion calling upon the directors to advertise the business for sale, and contended that that should be the substantive motion before the meeting.

After a prolonged discussion lasting nearly two hours, in which Mr. Fellowes, Mr. Gerard, Mr. Parrish, Mr. Gwynne, Mr. Lawrence, Mr. Phillips, Major Scriven, and others took part, the following resolution was, by agreement, submitted by the chairman and carried with but one dissentient:—"That the directors be instructed to consider the best means of disposing of the property, goodwill, &c., of the company; or, in the alternative, to consider the advisability of carrying on the business; and that they are instructed, if a sale be determined on, to advertise for sealed tenders for the purchase of the business; or to make such other arrangements for the disposal of the business and assets as they and the committee hereinafter mentioned shall think fit; that Mr. Dillwyn Parrish, Mr. Gwynne, Mr. Phillips, and Mr. James Fyfe be and are hereby appointed a committee to act with the directors in negotiating such sale, subject to the consent of the shareholders being obtained before any proposal for the purchase is finally accepted, or in arranging for carrying on the business."

The South of England Telephone Company, Limited.

THE directors, in submitting to the shareholders the statement of accounts for the year ending April 30th, 1888, state that the expenditure on capital account during the past year amounts to £16,457 6s. 9d., bringing the total of that account to £44,384 6s. 8d.

The revenue account shows a sum of £12,354 10s. for subscriptions and rentals, and a net credit balance of £3,905 12s. 2d., making, with the sum of £1,058 9s. brought forward from last year, an available balance of £4,964 1s. 2d.

After providing for the preference dividends (£1,849 0s. 6d.), which have been paid, a balance of £3,115 0s. 8d. remains, out of which the directors recommend the payment of a dividend on the ordinary shares at the rate of ½ per cent. for the year, free of income-tax, which will absorb the sum of £1,500.

The directors also recommend the transfer of £500 from the revenue balance to a reserve fund account, in order to commence this fund—as suggested by the auditors—leaving a balance of £1,115 0s. 8d. to be carried forward.

The completed trunk lines are as follows:—Brighton—Shoreham; Brighton—Worthing; Brighton—Lewes; Margate—Ramsgate; Dover—Folkestone; Chatham—Maidstone; Norwich—Great Yarmouth; Northampton—Wellingboro'.

The trunk lines in process of construction are:—Canterbury—Dover; Canterbury—Ramsgate; Canterbury—Deal; Lewes—Eastbourne; Wellingborough—Kettering.

At April 30th this year 1,435 exchange lines and 373 private lines were completed; and 86 exchange lines and 13 private lines were in course of construction.

Telephone exchanges are now open at the following places:—Brighton, Cambridge, Canterbury, Chatham, Dover, Eastbourne, Folkestone, Great Yarmouth, Hastings and St. Leonard's, Ipswich, King's Lynn, Lewes, Maidstone, Margate, Northampton, Norwich, Oxford, Peterborough, Ramsgate, Reading, Shoreham, Tunbridge Wells, Wellingborough, and Worthing.

United Telephone Company, Limited.

THE report of the directors for the year ending 30th April, 1888, is as follows:—Capital expenditure.—A reference to the capital account will show that up to the 30th April, 1888, the sum of £263,876 10s. 10d. has been expended upon the works in connection with the metropolitan district and instruments on royalty in the metropolitan district and subsidiary companies; being £35,695 18s. 8d. more than the outlay shown in the last balance sheet.

Revenue.—The revenue accounts, exclusive of metropolitan district royalties, show that the receipts of the company from all sources properly attributable to the year have been £143,134 18s. 5d., as against £130,704 7s. 5d. in the preceding year, or an increase of £12,430 11s. 0d., and the expenditure (including snowstorm losses and allowances, £15,653 8s. 7d.) has been £73,519 8s. 8d., as against £66,954 11s. 8d., or an increase of £6,564 17s.

Working Expenses (Metropolitan District.)—The working expenses for the year have been £35,724 12s., as against £30,483 14s. 2d. for the preceding year, or an increase of £5,240 17s. 10d.

Dividend.—The balance of net revenue account is £68,697 4s. 1d., of which amount the sum of £22,377 15s. has been absorbed by the payment of an interim dividend at the rate of 10 per cent. per annum for the first half year ending 31st October, 1887, and the directors recommend a further dividend of 10s. per fully paid £5 share and 5s. per part paid share for the second half year ending 30th April, 1888, amounting to £44,755 10s., making a total dividend of 15 per cent. for the year, leaving a balance of £1,563 19s. 1d. to be carried forward.

Reserve Account.—A sum of £14,375, being the amount received during the year as premium on new shares, has been carried direct to the reserve fund.

Directors.—It is with the greatest regret that the directors have to refer to the decease of the late Mr. E. Dwyer Gray, M.P. To fill the vacancy thus occasioned, they have, subject to confirmation by the shareholders, elected Mr. Frederick R. Leyland to a seat on the board. Mr. John W. Batten and Mr. Frederick R. Leyland retire by rotation, and, being eligible, offer themselves for re-election.

The Eastern and South African Telegraph Company, Limited.—This company notifies that the coupons, due July 2nd, on the Five per Cent. Mortgage Debentures, will be paid on and after that date at the banking-house of Messrs. Barclay, Bevan and Co., 54, Lombard Street, E.C.

Manitoba Electric and Gas Light Company of Canada.—Messrs. Robert A. McLean & Co. will pay, on and after July 1st next, the half-yearly interest coupon on the First Mortgage Six per Cent. Bonds for £62,000 of this company.

The Telephone Company of Austria, Limited.—The directors notify that coupon No. 7 of their Five per Cent. Debentures, due July 1st next, will be paid, less income tax, on and after July 2nd, by Messrs. Martin & Co., 68, Lombard Street.

The West Coast of America Telegraph Company, Limited.—The coupons due on the 30th inst. on the debentures of this company will be paid by Messrs. Barclay, Bevan, & Co. The coupons must be left three clear days for examination.

TRAFFIC RECEIPTS.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending June 22nd, 1888, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £3,385.

The Brazilian Submarine Telegraph Company, Limited. The traffic receipts for the week ending June 22nd amounted to £4,072.

PROCEEDINGS OF SOCIETIES.

Physical Society, June 9th, 1888.

Prof. Reinold, F.R.S., President, in the Chair.

Mr. J. L. Howard, D.Sc., was elected a member of the Society.

The following papers were read:—"On a Method of Comparing very Unequal Capacities," by Mr. A. H. Fison, D.Sc. One coating of each condenser is joined to earth and to one end, A, of a high resistance (20,000 or 30,000 ohms), through which a current is flowing. The small condenser is charged to the P.D. existing between the ends, A, B, of the resistance and discharged into the large one. This is repeated a great number of times. If C be a point between A and B, the resistance between A and C may be varied until the P.D. between them is equal to that between the coatings of the condensers after n operations. If the insulated coatings be now joined to C through a galvanometer, no deflection will result. The relation between the capacities, C_1 and C_2, of the large and small condenser is given by

$$\left(1 + \frac{C_2}{C_1}\right)^n = \frac{R_{AB}}{R_{BC}}$$

where R_{AB}, R_{BC} are the resistances between A, B and B, C respectively. Since time is required to perform the operations, the instantaneous capacities cannot be compared, and accordingly the measurements are taken after a definite time of electrification. A special rotating key was shown for performing ten operations per revolution, in which a trigger arrangement was provided for stopping the rotation after a predetermined integral number of revolutions. The method has been used for comparing a small air condenser with a microfarad. The capacity of the power was also calculated electrostatically (correction being made for the edges), and that of the latter measured electro-magnetically by a ballistic galvanometer. The results give a value for v equal to $2{\cdot}965 \times 10^{10}$. In these experiments the capacity of the rotating key was allowed for. Under favourable conditions capacities in the ratio of 1 to 1,000 or 1 to 10,000, can be compared with an accuracy of one-quarter per cent.

Prof. Ayrton thought the novelty of the arrangement was in the rotating key, as the method of comparing unequal capacities by charging the smaller and discharging it into the larger a considerable number of times, had been described and used by himself and Prof. Perry in their experiments on the Specific Inductive Capacity of Gases.

Mr. W. Lant Carpenter exhibited a new form of lantern, recently constructed by Mr. Hughes, of Dalston. The mahogany box is hexagonal and each of the three front sides is provided with condensers and projecting arrangements. The back opens to give access to the radiant which in this case is a Brockie-Pell arc lamp, but, if necessary, a lime light can be readily substituted. The lamp is fixed to the base board, and the body can be rotated through 60° on either side of the central position, thus allowing any of the three nozzles to be directed towards the screen. The three sets of condensers are placed so that their axes intersect at a point, about which the radiant is placed. The centre nozzle is fitted as a lantern microscope, with alum cell and various sets of condensing lenses and objectives, and a space in front of the main condensers is provided for polarising apparatus. The focussing arrangement consists of a skew rack and pinion and a fine screw adjustment; and the whole microscope can be easily removed and a table polariscope substituted. The right-hand nozzle is arranged for the projection of ordinary lantern slides, and the left-hand one is provided with an adjustable slit for spectrum work. A small table sliding on rails serves to carry the prisms, and the same rails support projecting lenses.

Prof. S. P. Thompson congratulated Mr. Lant Carpenter on his selection of the Brockie-Pell lamp as the radiant, for in addition to its being a focussing lamp, it is unique in the fact that it works satisfactorily on either constant current or constant potential circuits.

"Note on some Additions to the Kew Magnetometer," by Prof. H. Thorpe, F.R.S., and Prof. Rucker, F.R.S. In their magnetic survey of Great Britain and Ireland the authors have experienced considerable difficulty in making the necessary adjustments of the small transit mirror used for determining the geographical N. point from observations on the sun. To make the required adjustment it is necessary to obtain an image of the cross wires reflected from the mirror, and, owing to the large amount of extraneous light, and the insufficient illumination of the cross wire, the image is difficult to see. To exclude extraneous light a tube is placed between the transit mirror and the telescope, and a small screen placed behind the mirror. The cross wires are illuminated by light reflected from a small platinum mirror introduced between the eye piece and the cross wires, which are viewed through a hole in its centre. The mirror is placed at 45° to the axis, and reflects a considerable quantity of light on the cross wires when directed towards a bright part of the sky. In some cases it is advisable to take observations of the sun without first adjusting the transit mirror, and afterwards correct the error introduced thereby. To do this, a finely divided scale is placed in the plane of the cross wires, and from the position of the image, as indicated on the scale, the correction can be made. Observations taken with the mirror in adjustment, and others taken when out of adjustment, and subsequently corrected, give very concordant results.

The Rev. Father Perry said the improvements described were of great importance, for difficulties similar to those experienced by the authors had caused him to abandon the Kew magnetometer for field work, and to use a theodolite instead.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1887.

6104. "Improvements in electrical measuring instruments." A. Le Neve Foster and F. V. Andersen. Dated April 26. 8d. Relates to instruments of the class known as electrometers, and consists mainly in constructing the movable part or needle bipolar so that it receives simultaneously two electrical charges, one positive and the other negative, and in arranging this bipolar needle between two pairs of inductive plates which are charged simultaneously with the needle by electric potentials of opposite polarities. The claims are 3 in number.

6219. "Improvements in or connected with induction apparatus and the use of it in studying dynamo-electric machines." J. Swinburne. Dated April 28. 6d. Claims:—1. Induction apparatus for studying dynamo machines, consisting of a scale model and apparatus for measuring the induction in parts of it. 2. Dynamo-electric machines or motors constructed from data obtained from a scale model, substantially in the manner described.

6221. "A mode of and apparatus for governing or regulating by electro-chemical action, applicable to the regulation of motors and of the feed of arc lamps and for other regulating purposes." A. Shippey and W. J. L. Hamilton. Dated April 28. 11d. The inventors utilise the pressure of gas or gases which are generated and set free electrolytically by passing a current of electricity through acidulated water or other electrolyte so as to decompose it for governing or regulating purposes generally, the said gas pressure being caused to act upon one or more loaded pistons, diaphragms, or equivalent mediums of resistance. The current of electricity may be generated by a dynamo machine or other generator of electricity. If generated by a dynamo machine the aforesaid governing appliance is applicable for regulating the speed of the steam engine, gas engine, petroleum engine, hydraulic motor, turbine, water wheel, or any other motor which drives the dynamo, by acting on the throttle valve, expansion valve or other part, of whatever nature, for admitting motive fluid to the motor. A special small dynamo may be applied to generate the current required for the governor, or the current may be derived from the current created by a larger dynamo supplying current to electric lamps or to other purposes. The governor may also, for instance, be used to regulate and adjust the feed of the carbons in an arc lamp in due proportion to the current passing through the lamp, the current required for the governor being derived from the current passing through the lamp. The claims are 11 in number.

6581. "Improvements in holders for electric lamps." E. Manville and W. L. Madgen. Dated May 4. 8d. In one form of the holder the inventors make use of a "spun," "stamped" or "turned" base of brass or other convenient material, having a thread on one end to engage with the thread on the bracket or similar fitting, and having in the other end an insulating disc of well-burned pipeclay or other insulating material, moulded so that it has an opening or openings for the leads to pass through, and being provided with contacts and terminals. The claims are 5 in number.

6754. "Improvements in and connected with dynamo-electric machines." R. E. B. Crompton and J. Swinburne. Dated May 9. 11d. Relates to shaping the pole-pieces and magnets of dynamos, and to the arrangement and disposition of the iron and conductors of the armature and interpolar air space; also relates to means or methods of attaching the armature to the shaft, and to the ventilation of armatures of the kind known as the drum, for two or four pole machines; also relates to the collection of currents of dynamo-electrical machines, and to the avoidance of sparking and of cutting of the commutators; also relates to coupling the armature conductors of drum armatures across the ends in such a way as to facilitate repairs and to allow ventilation. The claims are 12 in number.

6917. "Improvements in electric transformers, induction coils, or induction resistance coils." W. M. Morpey and C. E. Webber. Dated May 11. 8d. Relates to improvements in electric transformers, induction coils, or inductional resistance coils, and has for its object to so construct such transformers or coils that they are inexpensive and simple, are not subject to undue heating, have a high degree of efficiency, and can be easily separated for examination or repair without unwinding. The claims are 4 in number.

6933. "Improvements in the insulation and laying of electrical conductors and in apparatus for that purpose." D. Nicoll. Dated May 11. 8d. Claims:—1. The use for insulating and protecting electrical conductors and their receptacles of the described compound called "Nicoll's compound No. 2" (a pitch composition). 2. The use for preparing and heating compounds for insulating and laying electrical conductors, of jacketted mixing and heating cauldrons, constructed and operating substantially as described, whereby the said compounds are prevented from becoming charred. 3. Constructing continuous conduits for electrical conductors of slabs of brick material wholly or partially with vitrified surfaces or other suitable material, fitted together end to end and side by side, the slabs having longitudinal semicircular grooves in their meeting sides, forming together closed channels in which are contained the coated conducting wires, substantially as described.

8159. "Improvements in effecting electric telegraphic communication, applicable especially for telegraphing to lighthouses, either floating or on rocks at a distance from the shore, or for telegraphing to and from vessels." Willoughby Smith. Dated June 7. 8d. Claim :—Signalling from or to a floating or other lighthouse, signal station, or vessel at a distance from the shore by the use of two submerged metallic plates or masses fixed to or suspended from their opposite sides, and of two other metallic plates or masses also submerged on the two opposite sides of the lighthouse, signal station, or vessel, but at such a distance from it as to be in sufficient depth of water not to be disturbed by waves, and insulated conductors leading from these latter plates either directly or through induction apparatus to a station on shore, where they are connected either to a telephone or to apparatus for sending alternating or broken electrical currents as required—the pair of plates connected with the lighthouse, signal station, or vessel being similarly connected through insulated conductors with a telephone and transmitting apparatus.

8708. "Improvements in apparatus for fixing telegraph posts." J. Oppenheimer. Dated June 16. 8d. The inventor makes each earth plate of a plate of steel, wrought iron or other suitable cheap metal, except cast iron and malleable cast iron. He forms the earth plate with corrugations, which corrugations he produces by a stamping process or by rolling, or by hydraulic or other pressure or in cases in which the earth plate is formed of cast steel he produces the said corrugations by casting. The corrugations may be formed by one operation or by a series of operations. Between the earth plate and the telegraph post to which it is to be applied he places a metal packing or bridge-piece to bed against the corrugated surface of the earth-plate. He secures the earth-plate, telegraph post and metal packing or bridge-piece together by means of a strap provided with screws and nuts. Between the nuts above mentioned and the earth-plate he places a plate or washer or plate and washer or plates or washers or plates and washers having a surface formed to correspond with the contour of the corrugations upon the earth-plate. The claims are 3 in number.

8710. "Improvements in electrical apparatus to be used with ordnance to fire the charge." T. Nordenfelt. Dated June 16. 8d. The charge is contained within a metal cartridge case and in the centre of the base of this case a tube is inserted to receive the priming enclosed in an inner tube or lining. There is a plug of vulcanite behind the priming, and a fine wire is passed through perforations in the plug. This wire when heated by the passage of the electric current ignites the priming charge. The claims are 6 in number.

8855. "Improvements in and appertaining to electric piles and plates therefor." E. Julien. Dated June 20. 11d. In this invention the electrodes are formed of a metallic inoxidisable plate which is the support for the active matter. For the construction of the supporting plates the inventor produces a composition, the component parts of which are fixed definitely in the following proportions :—94 parts of lead, 4½ parts of antimony, and 1½ parts of mercury, in 100 parts by weight. The claims are 16 in number.

9853. "Improvements relating to dynamo-electric machines." H. Watt. Dated July 13. 8d. Claims :—1. A dynamo-electric machine wherein the field-magnet consists of a single core wound with insulated wire, and placed at right angles to the armature-spindle and provided with pole-pieces or polar extensions, substantially as and for the purpose set forth. 2. An armature comprising a drum or "former" of non-magnetic material, provided with flangs between which soft iron wire is wound or discs of iron are placed, and in or upon which are secured insulated copper bars, substantially as described with reference to the drawings. 3. A dynamo-electric machine constructed with one or more electro-magnets, each comprising a central core upon which are placed concentrically iron cylinders, tubes, or casings, and coils of insulated wire, substantially as described, the said coils being coupled or connected as above specified.

13970. "Improvements in the mode of and means employed for automatically administering medical electricity to the human frame, also applicable for other purposes." M. Nightingale. Dated October 14. 8d. Has for its object the administration of a current of electricity to the human frame, the completion of the electrical circuit being effected automatically by turning a handle which acts as a conductor and regulator of the strength of the current. The claims are 3 in number.

16709. "Improvement in electrical generators." T. A. Edison. Dated June 13. 8d. Relates to the apparatus described in the No. of the Review for September 9th, 1887.

CORRESPONDENCE.

The Weymersch Battery.

In your report on the performance of the Weymersch battery, you say that you will be glad to hear if any of your readers have obtained results approaching it.

I for one, have done so with a simple nitrate of soda and sulphuric acid depolariser, and I have no doubt but that many other of your readers have also.

Your results are so like those obtained with this depolariser, that in the absence of any statement to the contrary, one can hardly fail to think them identical.

With reference to your last paragraph I, and doubtless many others, will be glad to know the composition of the solution, if any patent rights exist on it, and where it may be obtained at 6d. per gallon.

By-the-bye this is just what my nitrate of soda solution costs to make.

Harry T. Barnett.

June 23rd, 1888.

[We fancy we recognise in Mr. Barnett the inventor of a secondary battery which was tried some years ago at Paddington, described in the Review at the time, and of which we heard no more. Be that as it may, however, and we only mention the matter to show that our correspondent has had some experience in battery formation, he is not correct in his supposition that his depolarising fluid and that of M. Weymersch are identical. We should be glad to have the opportunity of perusing a copy of Mr. Barnett's tests.]—Eds. Elec. Rev.]

Mr. Mordey Anticipated!

I notice in your issue of June 1st, just received, a description of the Mordey alternator.

Permit me to state that I have had in operation at my laboratory, since July, 1887, a machine employing the same type of field magnets adopted by Mr. Mordey.

William Stanley, jun.

Great Barrington, Mass., *June 13th*, 1888.

A Very Curious Phenomenon.

I must apologise for taking up your valuable space with what will be of no interest to the majority of your readers, but for the information of those who are puzzled, perhaps you will allow me, in default of other explanation, to explain that what is said to be a "very curious phenomenon" by Mr. Reginald J. Jones, A.S.T.E., in a paper read by him before the Old Students' Association at the Finsbury Technical College on May 29th, and reprinted in your last issue, is so far, as is evident from Mr. Jones's description, nothing more than a demonstration of the primary law of electricity.

If Mr. Jones, on the circuit of very high tension to which he refers, has an earth of comparatively high resistance at one end of the line, he will find that in placing one incandescent lamp to the other main and to earth, and then in placing 18 in series in the same way, he will get almost the same current through the 18 lamps as through the one.

It will only be necessary in order to demonstrate the matter to refer to the case as a continuous current circuit.

$$\text{Ohm's law says } C = \frac{E}{\Sigma R}.$$

Let us for simplicity suppose that the resistance of each lamp is 10^{ω}; that the resistance of the fault to earth is 2000^{ω}; that the E.M.F. on the line $= E$; current with one lamp in circuit $= C$, and with 18 lamps $= C_1$,

$$\text{then } C = \frac{E}{2000 + 10},$$

$$\text{and } C_1 = \frac{E}{2000 + 180},$$

$$\therefore C_1 = \frac{2010}{2180} C,$$

which is only a small difference in the two currents.

J. M. G. Trezise.

Redruth, *June 26th*, 1888.

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